DESH BANDHU
G.S. AULAKH

ENVIRONMENTAL EDUCATION

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(Report of the National Seminar on Higher Environmental Education held at the Indian National Science Academy, New Delhi during July 30-31, 1979)

Editor

DESH BANDHU
G.S. AULAKH

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PREFACE

The seventies of the twentieth century will be known in the history of man the decade of Environmental revolution. The seventies started with the beginning of MAB programme of the UNESCO, witnessed the United Nations Conference on Human Environment (Stockholm 1972), Human Settlements (Vancouver 1976), Water (Mar del Plata 1977), Desrtification (Nairobi 1977), UNEP-UNESCO Conference on Environmental Education (Tbilsi 1977) and the UN Conference on Science and Technology (Vienna 1979). The question why environmental education, has been discussed more than enough and the Governments as well as the individuals realise well the importance of Environmental Education. The Environmental Education interest in recent years from both intra-curricular and extra-curricular point of view, although comparatively new, has been extremly keen and gathering momentum both within formal and non-formal systems.

In India, the Environmental Education is introduced at various levels. The goals of Environmental Education programmes in India are : to improve the quality of environment to create an awareness among the people on Environmental problems and conservation, to develop skills to solve the environmental problems; to creat the necessary atmosphere to make it possible for the citizens to participate in the decision making and to develop the capabilities to evaluate the development programmes and awarness of the economic, political and ecological interpendance.

The Environmental Education at Higher Level in India is provided by the Universities, Research Institutes, Schools of Planning and Management, Agricultural Universities, Engineering colleges and a number of other agencies. Some of them have defined programmes of Environmental Education and the others have included some component of Environment in their curriculum. Some of the institute also provide multidisciplinary programmes and some times these programmes are problem solving oriented. In recent years the programmes on Enviromental Biology has been introduced in several universities. The Schools of Planning and Management are developing programmes on Environment Impact Assessment so that the development progrymmes can be more environmentally sound. The concepts of Economic Benefits of Environmental Management Policies are also under considerations by a number of institutes.

The Indian Environmental Society in association with the International Programme on Environmental Management Education (CEI/UNEP) organised National Seminar on HIGHER ENVIRONMENTAL EDUCATION in New Delhi during July 30-31, 1979 at the Indian National Science Academy. The seminar was attended by a large number of experts of Environmental Education. The representatives of University Grants Commission, Department of Science and Technology, Universities and United Nations Environmental Programme attended the seminar. The seminar had close look on the question of Environmental Education at higher level. The seminar formulated a number of recommendations and the same were circulated widely and to the concerned Departments.

A large number of papers on various aspects of Environmental Education were presented during the seminar. The papers include the status of Environmental Education in different institutes, the strategies and needs of Environmental Education and the employment opportunities of Environmental gradutes. It has, therefore been decided to publish the selected papers in a book form, for wider circulation. We are sure that this publication will be of considerable interest and profit to all those who are concerned on Environmental Education.

We would like to thanks the International Programme on Environmental Management Education (CEI/UNEP), Department of Science and Technology, for their financial assistance, which made the seminar and this publication a success. We are thankful to Professor D.S. Kothari and Professor R. Misra for their kind addresses and encouragement in organising this seminar. We are also thankful to Indian National Science Academy, New Delhi for their help in providing facilities to hold the seminar. The thanks are also due to Dr. D. Shankar Narayan for his kind help during the seminar and we are also thankful to the contributors of this volume.

New Delhi
January 20, 1981

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G.S. AULAKH

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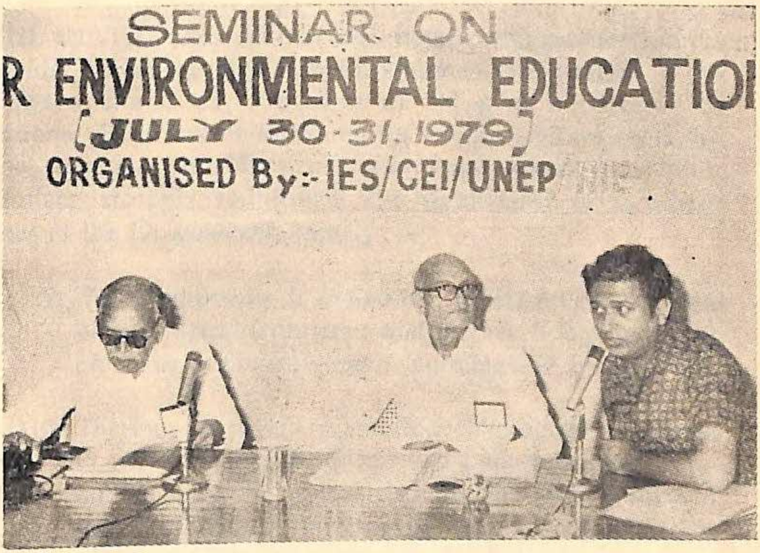

Prof. D.S. Kothari, Prof. R. Misra and Dr. Desh Bandhu,
at the Inaugural Session

1

Recommendations

THE NATIONAL SEMINAR noted with satisfaction the rapidly increasing interest in Environmental Education in our Universities and an awareness of its great importance for national development-plans and for human welfare generally. The several valuable presentations and discussions in the Seminar strongly re-inforced the significance of two *basic facts* of the *Environment*, namely :—

(i) *The Environment is Indivisible.* It has no geographical or ideological frontiers ; and further it is common to *all* living organisms—man, animals and plants.

(ii) There is no *purely* scientific-technological solutions to environmental problems and pollution. Any meaningful solution necessarily, in the very nature of things, extends beyond the realm of science and technology : *A human (or moral) dimension is an essential component to all such solution.*

Further, to meet successfully the present very dangerous environmental situation it is essential that everyone makes a contribution, no matter how so small.

All these considerations emphasize the extreme importance of incorporating—indeed integrating—Gandhian thought and values as a part of environmental education. Where the *human component is* missing, it is no environmental education.

The National Seminar, therefore, strongly recommends that Environmental Education should be closely linked with revelant Gandhian thought and values. This is particularly important in the context of Environmental Problems of our country. The Seminar requests the Chairman Professor R. Misra to appoint, in consultation with the UGC, a panel to work out details of such an integrated course for circulation to, and comments of, the Universities and other interested organisations.

In developing such programmes, the seminar made the following specific recommendations, which should be taken into consideration by different agencies concerned with Environmental Education :—

1. The Environmental Education should result in the development of an ecological ethics—a change in attitude of man towards man, Society and nature, in realisation of man as part of nature not alien to it. The Environmental Education should enable the individual and the society to perceive environment in its totality—an integration of Physical, Biological, Socio-cultural and Economic components.
2. While the Environmental Education at school level and undergraduate level should create environmental awareness, the EE at higher level should develop basic knowledge and skills required to solve emerging environmental problems. The EE should be so designed as to integrate the environmental concepts with existing courses. This requires that adequate quanta of social and natural sciences are made compulsory in all kinds of formal education at first degree level.
3. Separate interdisciplinary and integrated courses in environmental sciences should be established at two levels :—
    (a) A re-orientation course suitable for professional groups such as teachers, doctors, engineers, planners and social scientists, including adminis-

trators and decision makers.

(b) comprehensive course both at first degree levels in order to provide EE personnel, environmental planners and specialists for preparing Environmental Impact studies and reports.

4. The University Grants Commission and Department of Science and Technology and other similar organisations should provide support to educational institutions and also to NGOs for organising re-orientation courses for different target groups.

5. The University Grants Commission should accord high priority in establishing courses in colleges/universities and other institutions as visualised in recommendation 3b.

6. The inter-disciplinary research projects on environmental problems should be so organised as to provide for development of indegenous material for training in environmental education.

7. The individual with environmental awareness/training in environmental sciences should be given priority in recruitment at all levels.

8. Environmental considerations should be integrated into the planning process and environmental scientists should be involved at all stages of development programmes, national, regional and local.

9. The EE reading materials should be produced according to the local needs. The text books, and teaching aids should be developed to supplement instruction. The courses should include core area, optional areas and also project work of local relevance.

10. A data bank and Ecosystems information base/system should be developed so that the required informa-

tions are available at a central place. This data bank should support Environmental Sciences activities. It should be multidisciplinary, comprehensive and multipurpose in nature, enabling both short term solutions and long range planning for Resource utilization, management and Environmental problems.

2

Environmental Education-Needs and Strategies

Desh Bandhu

ENVIRONMENTAL Education is the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relations among man and his bio-physical surroundings. Environmental education also entails practice in decision making and self-formulating a code of behaviour about issues concerning environmental quality.

The introduction of the environmental education programme require the involvement and participation of teachers, students, administrators.

A committee including the students, administrators and teaching staff should be appointed to establish and evaluate the programme. The duties of the committee may be as below :—

(a) to develop the programme
(b) identify the changes needed to fully implement the programme
(c) to develop the strategy to implement the programme
(d) to maintain the effective communication between the community and education system

(e) evaluation of the programme in achieving the goals and objectives.

Goals and Objectives

The goals of the programme must be clear and specified. If the goals are not clear the objectives will not be achieved. The goal is to develop a citizanry that is aware of, and concerned about total environment and its associated problems and has the knowledge, attitudes, motivations, commitment, and skills to work together or individually towards the problems.

An environmental education programme, based on a sound pedagogical basis, should be directed towards achieving the following objectives which were formulated at the Tbilisi conference (UNESCO/UNEP Inter-Government Conference) :

Awareness : to help social groups and individuals acquire an awareness of and sensitivity to the total environmental and its allied problems ;

Knowledge : to help social groups and individuals gain a variety and of experience and acquire a basic understanding of, environment and its associate problems ;

Attitude : to help social groups and individuals acquire a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection :

Skills : to help social groups and individuals acquire sxills for identifying and solving environmental problems ;

Participation : to provide social groups and individual with an opportunity to be actively involved at all levels in working towards resolution of invironmental problems.

The ultimate goals of environmental education are threefold, namely.

(a) to foster clear awareness of, and concern about, economic social political and ecological interdependence in urban and rural areas ;

(b) to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;

(c) to creat new patterns of behavior of individuals, groups and society as a whole towards the environment.

Viewed in the perspective of these goals and objectives it would appear that the formulation of the curricula material on Environmental Education is of a more difficult nature than that of history or literature. A well designed programme should be based not only on the needs but also should be no the skills of the learner. It is important to review the literature regarding theories of learning, instruction, and of attitudes and behavioral change to serve as fuiding principles in the formulation, implementation, and evaluation of the environmental education program. The following are some of the points which may be considered in the formulation, implementation, and evaluation of the environmental education program.

(a) all environmental programs should be developed systematically and application of instructions should be based on the motivation of the learner and on the cultural environment around him.

(b) citizens are more likely to become involved in environmental issues if they personally feel that they can have some effect on decision and policy makers.

(c) the content of the curricula should not be too hard or too easy. The curriculum should include the social surroundings.

(d) students are most likely to throw themselves whole heartedly into any project if they feel that they have meaningful role and they are free in selection and planning of the enterprise.

(e) one of the key of the motivation is the discovering yourself and not having a generalization presented by teacher.

The curriculum projects should be planned horizontally as well as vertically. Disciplines, such as social sciences and science should not be studied in isolation. The curriculum should be flexible so material can be presented according to the background, needs and aspirations of the student.

The guiding principles of Enviornmental Education should be considered are as below :—(based on TBILISI CONFERENCE)

(a) consider the environment in its totality-natural and built, technological and social, economic political, moral, cultural and historical and aesthetic aspects :

(b) be a continuous *life long process*, begining at the pre-school level and continuing through all formal and non-formal stages ;

(c) be *interdisciplinary* in its approach, drawing on the specific contents of eaeh disciplines in making possible a holistic and balanced perspective ;

(d) emphasize *active participation* in preventing and solving environmental problems ;

(e) examine major environmental issues from local, national, regional and international points of views, so that learners receive insights into environmental conditions in other geographical areas.

(f) focus on *current* and *potential* environmental situations, while taking into account the historical perspective ;

(g) explicitly consider environmental aspects in plans for development and growth ;

(h) emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills ;

(i) promote the value and necessity of *local, national,* and *international co-operation* in the prevention and solution of environmental problems ;

(j) utilize diverse learning environment and a broad array of educational approaches to teaching and learning about and from the environment with due strees on practical activities and first-hand experiences ;

(k) relate environmental sensitivity, knowledge, problem-solving and values clarification at every grade level, but with special emphasis on environmental sensitivity to the learner's own community in early years ;

(l) help learners discover the systems and the real causes of environmental problems ;

(m) enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences.

The Environmental Education programme may include various desciplines. Some of them (can not be all) are given below :—

Ecosystem

This may include the structure and functioning of the ecosystem. The energy flow nutrient cycling, carbon and food cycling may also be included. The impact of man on ecosystem and how he is capable of altering the systems of the earth.

Population

The population structure, age grouping, causes of population increase, the impact of population on environment, migration, the use of resources by the increasing population, the life style of the populations, the birth-death rates, health and hygiene may be included in the population program. Other related problems like the population policy and its social, ecological, political and implications may also be included.

Economics and Technology

Economic systems constitute the social arrangements for producing and distributing the goods and services that individuals and societies desire. Some of the bussinesses and industrial plants create environmental problems such as pollution of air water and soil in the production of marketable goods at the social costs.

The economic system depends on the raw material, manufacture of goods, agricultural products. The economic system of one country may effect the economic system of other country (such as trade. prices of raw material in international markets, crop failures etc.) The relationship between population growth and environmental quality, between levels of production and environmental quality and between the degree of urbanization and environmental quality may be included in the EE program.

Environmental Decisions

In the process of making decision relating to environment should include the consideration of economic, political and social and technological aspects of the problems. It should also include all the possibilities of alternative solutions, policies and actions. In many it may be necessary to change or follow the law in order to reduce the environmental abuses.

The decisions can be changed by the active groups. Some of the groups and organisations may be more effective and may get the decision changed. The environmental decisions should seek to improve the lives of the society.

How to influence the decisions which are environmentally unsound and how to take environmetnal decisions may be the part of curriculum. This will lead to the action oriented approach of the program.

Environmental Ethics

Man is a part of this earth rather than careless exploiter of it. If we explot the nature in unwise manner it will be difficult to support even a small population. But if we protect the nature it will continue to meet the needs of all living things and not only for man.

The consideration of Environment as natural heritage may be the integral part of environmental education. Only when our life is guided by respect for the earth and all living things, we will be ableto live in harmony with our environment.

3

Environmental Education and Training

A.B.M. Musa

UNEP's Role

THERE EXISTS a general need for adequately trained personnel in all components of environmental management in the developing countries.

Similarly environmental education is important as appropriately trained personnel can effectively carry out their functions in management, supervision, communications and support services.

In view of the importance attached to Environmental Training and Education the first phase of the "International Environmental Education Programme" was conducted by UNESCO and UNEP from 1975-1977. This programme prepared a broad set of objectives and principles for developing environmental education at all levels in both formal and non-formal educational settings within countries and for strengthening international and regional cooperation to the same end. The main sets of quidelines were developed at the "International Workshop on Environmental Educational" convened in Belgrade in October 1975. They were reviewed

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This is not an official UNEP or UNITED NATIONS document. Opinion are that of the author.

at a series of regional meetings, including the "Regional Meeting of Experts on Environmental Education in Asia" held in Bangkok in Novemler 1976, and they were considered by the "Intergovernmantal Conference on Environmental Education" at Tbilisi, USSR, in October 1977.

Recommendation from the Asian regional meeting declared: That as a matter of urgency special post-graduate programmes on environmental education be established for training people already specialized.

Recommendations from the Tbilisi Conference subsequently endorsed this is effect, when it stated in part: "that UNESCO with aid from UNEP provide assistance as soon as possible to establish regional training programmes in the ESCAP Region, based on suitable existing national institutions, for the post-graduate training of environmental integrationists of the type that have been defined in the Report of the Asian Regional Conference on Environmental Education".

Meanwhile, the Governing Council UNEP, during its Fifth Session in May 1977, endorsed a proposal to establish Programme Activity Centres for Environmental Education in different regions, and in particular the Council urged "the early establishment" of such a centre in the ESCAP Region. In response to this, and in the light of recommedations arising from the UNESCO-UNEP International Environmental Education Programme, the UNEP Regional Office for Asia and the Pacific contacted a number of universities in the Region in late 1977. This was to enquire about their interest in and the possibilities for initiating a communications and exchange network among a consortium of universities and higher technical institutes which have the capacity to handle an "Integrated Environmental Education Programme (IEEP)."

Following an initial expression of interest in the idea of such a consortium from a number of universities and higher technical institutes in the region, a mission was arranged to visit nine ~~such institutions~~ during ~~April and May~~ 1978 in order to prepare a status report. The mission members were:

Professor (Emeritus) William E. Kershaw, University of Salford, U.K. lately School of Tropical Medicine, Liverpool.

Professor George R. Francis, Faculty of Environmental Studies, University of Waterloo, Canada.

Dr. Dhira Phantumvanit, UNEP Regional Office.

ENVIRONMENTAL TRAINING

Governmental training programme

The objectives of environmental training being undertaken by governments could be summarized as follows:

(a) To improve and increase awareness of, and concern for the environment by integrating the private sector and government sector's knowledge, skills, values and motivation;

(b) To provide specialized training required by technicians and specialists in relation to environmental assessment and management;

(c) To promote participation in environmental awareness among rural and urban communities.

The target group of this integrated activity includes:

(a) Teachers

(b) middle-level manpower in selected areas

(c) professionals and other specialists.

Bangladesh has initiated a non-formal environmental training programme both for young people and adults through mass media. Due to the successful national media seminar on "Environmental Awareness for Journalists and Other Media People" held in Dacca on 5-11 January 1979, the Government has reinforced its intention to organize more seminars and workshops for journalists and broadcasters.

In *India*, an environmental training programme for post-graduates has been on-going in the Public Health Engineering Department of the Jawaharlal Nehru University since 1948. The objective is to provide training courses for environmental scientists and specialists.

A number of non-governmental organizations in India are also active in environmental training. In service training particularly teacher-training receives high priority in the environmental education programme in India.

Community awareness training is stressed in *Indonesia* for the general public on matters of environmental concern particularly in interpreting local environmental problems for which timely intervention and action by the public is important, necessary and desirable.

The office of the Minister of Environment and Development Supervision has organized a number of training courses, particularly in the training of provincial development planners.

In *Malaysia*, activities related to environmental training are part of the general process of education including the development of public awareness of the danger of environmental degradation and the need in taking the various components of the environment into account.

In the *Philippines*, the National Environmental Protection Council has adopted the environmental impact assessment system as a total in the implementation of its environmental policy. It is with this in view that a series of teachnical workshop cum study tour for personnel of Governmental agencies and environmental co-ordinators from various implementing agencies have been organized.

As a follow-up of the Tbilisi Conference, *Thailand* proposes to host a Regional Centre for Environment and Resources study for Asia and the Pacific at the Faculty of Environment and Resource Studies, Mahidol University. The main goals are (i) to provide interdiscipiinary training in natural resources and environmental management, (ii) to assist governments and institutions through environment and resource research, (iii) to serve as a regional centre for education and exchange of expertise on these topics.

In the South *Pacific*, the University of South Pacific through its Centre for Applied Studies in Development has been active in injecting environmental dimension into the academic programme. Training courses for senior governmental officials are provided by the Centre together with other international agencies.

International training activities

One of the substantial activities of the Southeast Asian Ministers of Education Organization (*SEAMEO*) is related to environmental training and is being implemented by its regional centres. Training courses and seminars/workshops for professionals in tropical biology are conducted regularly by the Regional Centre of Tropical Biology (*BIOTROP*) and post-graduate courses in tropical medicine are offered under SEAMEO/TROPMED Teaching Programmes.

Over the years, *UNESCO* has been active in training activities related to environmental quality, human settlements and socio-cultural environment. A Human Settlements Managers Training Programme had been executed by UNESCO with the financial support from UNEP. UNESCO/UNEP also promote environmental training of engineers and other specialists.

The South Pacific Commission (*SPC*) in collaboration with the governments in the South Pacific organizes training courses in environmental management for decision-makers.

The Swedish International Development Authority (*SIDA*) finances environmental training courses particularly on marine environment. Governments in Asia and the Pacific have recognized the environmental requirement in the protection of living marine resources. An FAO/SIDA Workshop on Aquatic Pollution was held in Manila, 7 May—9 June 1979 with the intention to increase technical skills among qualified chemists in the region.

One of the training programmes being undertaken by UN/APDI emphasizes on environmental aspects of development and environmental bases for integrated rural development for decision makers and national planners. The major components of the programme, which is funded by UNEP, include:

—development of training courses on integrated approach to environment and development;

—development of training courses on specialized fields of development in relation to environment; and

—initiating a consultative meeting on statistics for environmental planning.

The Regional Offices of *WHO*, partially through the financial support of UNEP, have initiated technical workshops on air and water quality monitoring. These workshops serve in strengthening the national capabilities in environmental quality management and control.

One of the most well-known institutes of technology in the region, the Asian Institute of Technology (*AIT*) offers training programmes on water resources development, environmental engineering, human settlements, etc. Many of these programmes lead towards a post-graduate degree. Students attending AIT come from more than 20 countries in the region.

Major Needs for Environmental Action, Policies and Legislation and Plans for Meeting the Regional Needs

1. Many of the training courses offered in developed countries are too theoretical and parochial to be suited to the needs of developing countries. Of prime importance is the promotion of more regional and national training activities utilizing, to the extent possible, local expertise and emphasizing on case studies from the region.

2. Many of the key subjects of environmantal training are at the moment in a state of rapid development. Universities in developing countries enjoy the privileged status as centres of technical knowledge. Universities can respond quickly to the need for short, multidisciplinary introductory/overview courses on environmental matters. The role of universities in offering environmental training thus should be amplified.

3. In developing countries, state or provincial administrators are the responsible authorities who carry out day-to-day contact with the rural majority. Environmental training aiming at this target group will promote environmental consciousness which can be conveyed to the grass-root level.

4. Since the beginning of this decade, mass media in developing countries has given broad coverage of environmental topics. However, many environmental issues are scientific and technical in nature. A through understanding of the essence of these issues are necessary precautionary measure against any well-intentioned misrepresentation which may confuse the public and produce negative attitudes towards development. Training workshops for journalists and mass media personnel should be encouraged both at the national and the regional level.

4

Ecology, Energy and Environmental Education

K.C. Gupta

Introduction—Why Environmental Education

ALTHOUGH the 'Environment' has existed on our planet for millions of years and the basic sciences have been with us for at least a few centuries, yet it is only in the past decade or so that the scientists have started to pay attention to the subject of environmental education. One may ask why? We know from daily experience that liquids have no shape of their own; water takes the shape of the container in which it is put. In a highly simple—minded analogy, we may call the environment a container and the living objects—plants, animals and man—the liquids, though now the time scale is much longer. Over millions of years, all forms of life in our biosphere have undergone evoluationary changes consistent with the changing environment. It has been observed that despite the complex relationships, in the absence of outside disturbances, most populations remain either in a steady state for long periods or go through an orderly progression of successive stages ending in a steady state. Thus, all was nearly well before man started "playing" with the environment. Further, a population explosion of onyone species in a community can bring about profound, undesirable, and irreversible changes in the environment in which the community lives. The environmental damage caused by the unchecked growth of industries in the West and by the unchecked growth of human population in the East has already reached such proportions that it can be literally seen, tasted and smelled. Our air, our water, our land grow more polluted by the day as the technology and demand of production far outstrips our ability to preserve an environment hospitable to life. Certain forms of pollution have encroached rather shockingly on the landscape, that part of nature about which all of us have well-developed esthetic feelings. When man participates in the pollution and destruction of the environment around him, he unwittingly releases such forces that may bring about his own destruction. Man and environment are inextricably linked and what affects Man's environment is of concern to everyone—scientists, politicians, teachers and students. No longer is environmental education the sole concern of scholars of biological sciences. The knowledge and study of environmental problems is properly a subject of general education; it is only appropriate that people in the social sciences and humanities now find it as relevant as their colleagues in the natural sciences.

The environment is a complex, subtly balanced system, and it is this integrated whole which receives the impact of all the separate abuses inflicted by the technological culture of man. There is a definite possibility that the cumulative effects of the diverse, novel and potent pollutants released into the environment may be fatal to the complex, life supporting fabric of the biosphere. The costs of correcting past and present mistakes are already staggering; not only this, the technologies which have produced them are now deeply embedded in the economic, social and political structures of the developed nations. It is in this respect that the developing countries like India have an edge over the 'rich countries'. If we are willing to have a population policy and to readjust our goals on the so-called standard of living, we can restore and preserve the biological quality of our environment. Some consume nature to gain; but all of us must consume it to exist. It should be absolutely clear that environmental education and research is of as much relevance to India as it is to a rich country like U.S.A.

Ecology is Environmental Sciences

Basic to an understanding of what a crowded and crumbling environment can do to man is an understanding of ecology. Both ecology and economics, so properly derived from the Creek word 'Oikos'—the home, deal with the ordering of the habitat, and income and expenditure. Both deal with populations, communities, and systems. Economics has tended to deal with income and expenditure symbolized in money and the most dangerous act lies in mistaking the symbol for reality. Ecology deals with income and expendiutre in terms of energy cycles and food webs in communities of plants and animals and man, deriving essentially from the Sun. However, ecology goes beyond this. It is the science of organisms in relation to their total environment and the interrelations of organisms interspecifically and between themselves. The total environment includes all kinds of factors such as climate. soil, artificial inputs, etc. Of course, one must include man in the above scheme; however, there is one outstanding difference between man and the rest of living world ecologically. Man is a political animal and in modern times it will be quite un-real to ignore the political nature of man as an ecological factor. Once we accept a wider definition of ecological sciences, we realize that there is hardly any difference between the so-called environmental sciences and modern ecology. To give an example: though it is necessary to study the pollutants in a given environment, yet by itself this is not sufficient; what matters the most is how they affect the living objects in that environment. We may say that what ecologists in the modern sense are about is no less than building an understanding of the role of living things in the structure and function of the universe.

The basic unit of ecology is the species population, also known as population biology. Species population is the entity that has been adapted by modification of its gene frequencies to a particular ecological niche, that interacts with other populations in the same habitat, and that plays a unique role, though of varying importance, in the process of energy transfers in the systems of that habitat. As a matter of fact, this field includes all aspects of grouping of organisms and organisms in groups. We feel that there is much to be gained by taking a broad view in the study of populations in which use is made of the many similarities in the phenomena studied by the taxonomist, the ecologist, the geneticist, the behaviourist, the economist, and the mathematician. We must keep in mind that the boundaries of different sciences are not sharp but diffuse. A multi-disciplinary approach will need a careful study of techniques and procedures, in addition to an analysis of the language and the conceptual frameworks involved. Here, we would like to mention that sometimes one may confuse concepts with facts and then consider it unnecessary to investigate the facts further. Many concepts in present day population biology appear to have low information content and little operational meaning. This is discussed at length in a beautiful paper by Ehrlich and Holm. They point out that such concepts as "competition", "niche", "community", "species" and "population fitness" easily fall into this category.

Thus, we see that an important area of study and research for environmental scientists is population biology and there should be an endevour to develop a rigorous, quantitative and unified approach to problems at the highest level of biological organization.

Ecosystems and Systems analysis

Modern day ecologists find it more convenient to use the ecosystem, as a unit of study, rather than only the biological population. The term ecosystem was introduced about forty years ago by A.G. Tansley, although the concept itself is much older. According to Tansley, an ecosystem consists of all the living organisms together with the physical and chemical components of their immediate environment, interacting together in a system. The word "system" implies that "there is a set of elements or objects together with relationships between the objects and between their attributes". Every organism is affected by the conditions of the environment in which it lives, but every organism also has some effect on these conditions, however small, a kind of feedback in the system. The kind of trees growing in a particular region depends on the kind of the soil and the climate; but the kind of soil existing in that region is also in part a consequence of the kind of forest—coniferous, hardwood or other—and the density of trees in the forest has a definite influence on local, climatic conditions. In fact, a principal feature of a 'system' is that we can understand it only by viewing it as a whole and not in pieces.

We further elaborate by considering an 'abstract forest', in which we take into consideration the following components: trees, climate, insect defoliators, birds, spiders, hymenopterous parasites, insect diseases and of course man. Now suppose that in a particular year the spring season is unusually hot. This change in one variable will have the following effects: trees will grow faster flower early. So, insect defoliators that eat the flowers will have plenty of food and that too a bit earlier than normal, their own metabolic rates will be speeded up so that they can utilize the earlier available food to grow faster. Warm weather will have an effect on each kind of organisms that attack the pests, their metabolic rates too are speeded up. Disease which are most effective in cool, damp weather will be less effective than usual, and so on. Next consider the entomophygous birds, insect parasites and spiders. The birds eat the insect defoliators and so are in direct competition with the insect parasites and the spiders. The more pests the birds eat the less are available for other entomophagous organisms. Consider another aspect of the defoliators. They regulate the chance of survival of a tree, and hence the economic life of the human settlement in the area which earns a living by cutting down the trees. The defoliators govern the density of all their enemies because as the pest larvae build up in density from year to year, the birds, spiders and parasites will show various degrees of numerical response to this in order to exploit fully the increased availability of food.

Thus, in the example given above, we find that everything affects everything else. Same is true about any 'system'. We are free to study only a few components at a time for a given system, and many times such a study too has its uses; however, in order to understand underlying interactions in a system, it is absolutely nesessary to analyze it in its totality. The reciprocal interactions between organisms and their environment are particularly striking in the case of human species. Our day to day activities are influenced in many ways by the nature of the physical setting in which we live—inland, coastal, desert, forest, etc.—however, we in turn are more capable of altering the environment with unprecedented speed and effect.

It is broadely accepted by ecologists that the most complex ecosystems are the most stable in that they are least liable to rapid fluctuations in the number of individuals of a particular species from year to year. Also, a very simple ecosystem is usually in a critical state and hence is liable to catastrophe. Here, the term 'complexity' is used in the sense of larger number of different species. Many actions of man may be looked at as deliberate attempts to simplify the biological relations within the natural ecosystems to his advantage. By clearing land and planting crops a complex of mixed species of wild plants may be replaced by a single kind of plant—a mono—culture. Similar simplification is forced on nature by clearing forests for construction and industrial purposes. Modern man, due to over population, depends on the simplified food relations of intensive, mechanized agriculture. The decomposer part in the food web is greatly modified as plant growth is maintained by adding chemical fertilizers to the soil; use of pesticides reduces or even eliminates competition. Such simplified relationships are efficient as long as they can be sustained. There is no doubt about the effectiveness of this type of intensive agriculture to support a large human population but it also carries the danger of inherent imbalance. It must be realized that laws of nature apply to man as they do to all other living things; man is only one strand of a complex food web of the ecosystem, dependent not upon himself only but upon the total web, which nevertheless he has the power to damage beyond repair. It would appear both wise and desirable to preserve as much of the natural diversity as possible—at least until we understand the 'system' well enough to predict quantitatively the consequences of possible over-simplification.

Another important problem that merits investigation is how coordination, interdependence, and homeostatic mechanisms come into being and operate. This too necessitates a quantitative analysis of ecosystems. Ecosystems have a definite structure, and the 'real structure' of an ecosystem is a property that remains out of reach, but the 'complete structure' is reflected in many features of an ecosystem that can be subjected to observation. Some of these features are: the distribution of individuals into species, the pattern of food web, and the distribution of total bio-mass. In order to have a quantitative measure of structure, it seem convenient to select a name; Margalef has called it 'maturity'. In general, an empirical knowledge shows that the structure becomes more complex as time passes. Thus, we may call a more complex ecosystem a more mature system. An ecosystem, not subject to external disturbances, usually changes in a progressive and a directional manner. On theoretical grounds, the two most noticeable changes accompanying 'maturity' are the increase of the complexity of structure and the decrease of the energy flow per unit biomass. However, in the presence of a changing environment, the energy flow per unit biomass in an ecosystem may remain relatively high and system then is usually in an unstable state. Here, it should be mentioned that most of these concepts have yet to be fully established. The process of ecological successions is yet to be understood. A quantitative study of the bioenergetics of ecosystem development may tell us the principles underlying ecological successions.

From above, it becomes clear that a quantitative study of of ecosystems is fundamental to an understanding of the relationship between man and nature. At the level of organisms or populations, many times it is possible to gain an insight into the problem by constructing relatively simple models. However, at higher levels of organization, in particular for ecosystems, simple models are found to be quite inadequate. In recent years, it has been widely accepted that a proper approach to study an ecosystem is through 'systems analysis'. As a matter of fact, 'systems ecology'—comprising ecosystems and systems analysis—is slowly developing the capacity for considering all of the relationships and their interactions simultaneously. The notion of fully describing the optimum for any organism may seem presumptuous. It requires measurement of every type of response, and their statement as a series of coupled differential equations. However, synthesis in the from of a complex model and its numerical solution on a computer should permit a quantitative assessment of an optimum for the system as a whole. In my opinion, systems ecology should be at the top of environmental education and research at post—graduate level, particularly if we are interested in developing the subject as an exact science.

Energy and Resource limit Studies

When a population of organisms grows in a finite environment, sooner or later it encounters a resource limit. This limit to further growth in numbers is described by ecologists as reaching the "carrying capacity" of the environment. A similar limit must also be valid for man since his supporting environment is also finite. Few species of organisms ever really multiply to the absolute limit of their food supply under natural conditions, essentially because other controlling factors intervene. However, in the case of human species we have seen a fantastic growth in numbers in the past few decades. At present, the world population is doubling once every thirty-five years. Nearer home, India's population is projected to reach about one billion by 2000 A.D. Increasing population means increasing demand on energy and other resources. Due to intensive agriculture and the so-called green revolution, it may be possible to feed our ever growing population. However, there is an old saying that man does not live by bread alone. Once he is fed and clothed, he needs other "good things" of life—house, car, recreational facilities and all other comforts made possible by modern day technology. Such demands by an ever increasing population will obviously put a severe strain on the rapaciously depleting traditional energy sources. Even if alternate energy sources become commercially accessible, we should keep in mind that the activity of organisms is their environment is subject to the same physical laws which describe the interactions of non-living matter and energy transformations in non-living matter. Two such laws are the First and Second laws of thermodynamics. In general terms, first law of thermodynamics tells us that energy and matter can neither be created nor destroyed but only changed from one form to another. The second law implies that every transformation of energy or matter is less than hundred percent efficient. These together then tell us some of the limits of the possible. As our energy consumption grows, so does the amount of waste heat generated. There has been a theory around, mostly empirical, that man risks catastrophic climatological changes if the amount of heat he dissipates in the environment on a global scale reaches about one percent of the solar energy absorbed and reradiated at the earth's surface. If the world energy consumption keeps on growing, such a situation may arise in the year 2100 A.D. Keeping in view all the factors, it follows that energy and resource studies should be an integral part of environmental education.

Perhaps we should not talk in terms of 'energy' alone. In addition to energy, mineral and food resources, the quantity and quality of the human source itself are critical components of the equation. Man's own interests in the long run plead for a balanced relationship with nature and for less materialistic measures of well being and success of civilization. We must give up at the outset the ill-conceived notion that there are single, monolithic solutions to the multidimensional plight of man. Man can understand the environment only if he realizes his role and his responsibilities in the system and the cycles of which he is an integral part. We have erred in thinking that environment is simply a matter of managing natural resources.

Concluding Remarks

Courses on environmental education at post-graduate level should meet the twin requirements of: (i) educating a student in details on environment and related problems, and (ii) equiping him with sufficient knowledge and techniques to tackle these problems. In other words, some of the courses should be research oriented. In our opinion, both these demands are fulfilled if courses on Ecology in general and systems ecology, energy and resource utilization, and human ecology in particular form the major portion of total course load at this level of environmental education. Of course, whereever possible there should be sufficient emphasis on the local environmental problems and their solutions.

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Ecology and Environmental Education

H.B. Mathur & Krishan Pal

Introduction—The Environmental Challenge

WITH the advance of science and technology during the century, man has gained ever greater control over nature. Economic revolutions in commerce, agriculture and industry have brought increasing material abundance to more and more people. All efforts are being made to raise the standard of living of the masses. This is being done through large scale industrialisation with its advantages as well as disadvantages.

This rapid material progress has no doubt made life easier and happier but has put man face to face with a series of challenges. Of all the crisis facing man kind and there are many, it is rapid degradation of the environment due to pollution. We also see it, taste it, eat it, drink it and stumble through it. We literally live and breathe filth, and not surprisingly, it is begining to threaten our health, our happiness, our very civilisation.

Man is wasteful by nature and now his wastes are begining to burry him. To-day he walks through once sunny places with his head swathed in dirty brown smoke that stings the eyes and irritates the throat and lungs. He tries to swim in a once clean river, lake or ocean, and fights his way through mountains of trash and garbage that are begining to overwhelm him. Every year each one of us discards a ton of solid wastes, a family of four produces 8,000 pounds of such refuse, in addition to the tons of liquid waste, flushed down the clocked sewers of the nations, and to the tonnes of pollutants introduced into the air.

We have made septic tanks of many lakes, rivers and estuaries. We are polluting the ocean too. Europe's Rhine, which once teemed with salmon, can no longer support them. The Cuyahoga river in the United States recently burst into flames, so contaminated it is with chemicals.

Man has created not only great cities but disgusting slums. He has dug a wealth of mineral resources and left ugly gashes across the once lovely landscape. In his struggle to produce more and more food to feed the increasing population, man has polluted farms, fields, water and air with thousands of pesticide poisons. In addition to these pollutions, there has lately been added another-nois e pollution—which comes from our machines and vehicles, the noise of construction, production and destruction. The noise of transportation, all amplified music and non-music, attacks our ear-drums, our minds and our bodies, in ways, now begining to alarm doctors and scientists.

The over-all loudness of environmental noise is doubling every ten years. In some metropolitan cities, the noise level in 1968 was found to be four times what it was in 1956 and 32 times its value in 1938. This noise pollution of the environment has created a number of problems and is threatening to become a serious hazard. That tragic day, it seems, is not far off when, as predicted by the German Noble luerate Robert Koch, man would have to fight merciless noise as the worst enemy of health.

This ecological onslaught has agitated the minds of people, the world over, and it is not uncommon to-day to hear that basic necessities of life are no longer enough. There is now demand, in addition, the amenities, which enhance the quality of Living.

People are insisting on zero pollution-zero air pollutant emission, zero radiation discharges, zero pollutants in our rivers and streams. Today, a multidisciplinary host of environmental saviours from all walks of life, sociologists, damographers, psychologists, biologists, conservationists, lawyers and those interpid new comers—the ecologists—are ready to criticise the past short comings of the innocent engineer and to exercise rigid control over his future efforts, who, in the spirit of service, applied his know-how of materials and forces of nature to the benefit of mankind, in a good faith.

There is, however, no denying of the fact that unforseen hazards have resulted from spreading technology and they are now threatening man's very existance. The greatest challenge facing us today as individuals, as organizations. as a nation and as a civilized world is the proper allocation and management of our natural Resources, our human Resources and our Material Resources on a national or even a world wide basis in the context of improved environment on earth.

Man will have to relearn to integrate himself with his environment and to live in harmony with nature as taught by ancient religions and philosophies. The scientists and technologists will have to grasp the philosophy of oneness of life and learn to respect and protect animal and vegetable life, as in the final analysis human survival is dependent on them and human life can subsist only in harmony with nature and not by destroying nature. It is here that environmental education ecology which is the science of mutual relationship of organism to their environment becomes useful and essential.

Ecological Studies and Environmental Education

Environmental education is interdisciplinary in nature. It involves subject matter from natural sciences and the social sciences. It focuses on topic such as water, air, noise pollution which cut across the various subject matter disciplines.

It is a fusion of subject matter (content) and inquiry skills (process). Subject matter is the product of the process of investigation. It is fruitless to speak of content or process as being more important. They are equally important and should be regarded as an entity.

With the subject matter of environmental education as a central theme, students in the class room can use inquiry skills to explore almost every fact of man's interaction with his biophysical and social environment. They are able to get a clearer more unified, and better related understanding of the world in which they live since in the real world, all subject matter is inter-related and not arbitarily categorised according to special fields.

The goal of environmental education is to produce an active environmental-oriented citizen. Active describes an individual who is personally involved in decisions and practices regarding man's interaction with his environment. Environmental oriented, describes an individual whose values and attitudes are sympathetic to responsible use and management of the earth's resources. Citizens must be able to make decisions on environmental problems by using the most current and accurate information from the natural and social sciences. Educators must provide students with a set of experiences that give them the skill and concepts necessary to moke effective decisions.

Approach in Environmental Education

Environmental education should employ a problem solving approach. That is ecological issues are presented and pertinent questions are raised. A tentative hypothesis is made. Research is done in order to support or negate the hypothesis. The conclusion reached form the basis for intelligent decision and actions on environmental problem.

The teacher assumes the role of resource consultant rather than the dispenser of knowledge. He enters into the discussion when there is an obvious lag, when an arbitrator is vitally needed, or to reinforce a point made by a student. He withdraws from the discussion when students are able to get along on their own. He uses the strategy of the change agent by intervening at different structured points at different times. The challenging part of his job is to know when intervention is necessary.

Class discussion is useful when problems are raised and tentative hypotheses posed. It is also useful in clarifying the research findings of class members. It is most helpful as a means of testing hypotheses, generating conclusions, and determining the next course of action. Oral reports made to class by indlvidual members on results of research findings help to precipitate class discussions. An oral report is a monologue in which information is presented. The class discussion is a give-and-take in which information is presented, analyzed, evaluated and then denied, supported, or modified.

Contents of Environmental Education

The broad range of topics that could be studied are as follows:

Inter-relationship of resources (Ecology)
Natural Resources

(a) Air

(b) Water

(c) Plants

(d) Animals

(e) Soil

(f) Land as space (farm, range, forest, town transportation etc.)

(g) Earth Materials

(h) Energy resources (Sun, fossil fuel, wate-power, Atomic energy etc.)

(i) Radioactive pollution in water and air.

Role of Man

(a) Man and his resources

(b) History of conservation

(c) Quality of environment
    (i) Air quality
    (ii) Water pollution
    (iii) Pesticide pollution
    (iv) Solid wastes
    (v) Atomic wastes

(d) Social implications of conservation (economics, politics, esthetic, ethics)

(e) Population

(f) Planning—urban and regional

Environmental Controls

(a) Control of arthropods, mollusces, rodents and other alternative hosts of disease.

(b) Noise control

(c) Control of quality of surface water and ground water quality and waste water treatment.

(d) Air quality control.

Community Environment

- (a) Public recreation and tourism
- (b) Environmental health aspect of public beaches, swimming pools, camping sites etc.
- (c) Sanitation measures associated with epidemic emergencies, disaster and migrations of populations.
- (d) Administrative decision, air quality standards, control laws.

Projects with Ecology Content

Various projects which can be taken in ecology for environmental education are as follows:

Life Science

The project which can be taken in life science are as:

1. Variation investigations
    - (i) Physical variations
    - (ii) Variations in behavior
    - (iii) Variations in plants

2. Characteristic of Living things
    - (i) heredity of the house fly
    - (ii) heredity of the house mouse

3. Role of living things—Microscopic world.

4. Man's effects on the environment
    - (i) Man's effect on fresh water
    - (ii) Man's effect on air

Biological Sciences

- (i) Micro-organism in various process

(ii) Micro-organisms role in the degradation of industrial waste.

(iii) Biological science and environment.

Engineering Project

The approach is a problem solving one, aimed at analysis of the technological and scientific roots of social, political, economic, health and educational problems. Here we can have following:

1. Mathematical models
2. Sensing and Measurement
3. Computers
4. Optimization with constraints
5. Stability, instability and control
6. Systems analysis of ecological impact,

Populations Projects:

Earth Science Projects:

1. Soil study surround one's environment
2. Under ground water study
3. Materials testing and effect of environment on it
4. Other problems from personal experience.

Conclusion

There is no doubt that today our tiny planet is on the brink of an ecological disaster. Man has misused and defaced our land, water, and airs we are rapidly consuming our non-renewable resources and we have developed urban environments which, among other things, have bred wide spread dehumanisation.

There is an urgent need to (i) Restore the ecological integrity to ecosystems throughout the world (ii) develop and implement urban planning schemes which are ecologically sound (iii) Inculcate attitudes and values which are enduring —(such as the supreme value of human life, importance of shared group values, respect for natural environment).

Part of the broad response to the ecological crisis is the mobilisation of educational forces, completly hetrogeneous, which promises to help shape the knowledge, skills, and values of future citizens. The ecologically educated citizen must (i) have some basic knowledge of ecological concepts and facts (ii) have a basic knowledge of the socio-ecological problems of the urban environment (iii) understand his relationship with the natural world (iv) heve an understanding of abnormal ecology, or pollution, and over population (v) learn to make decisions based upon the best available evidence after detailed analysis of alternatives.

The need today of universal environmental education for proper ecological growth and awareness cannot be over emphasised.

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Soil & Water Conservation—An Aspect of Higher Environmental Education in India

P.N. Bhatt & R.K. Gupta

WHILE soil, water and vegetation are the three most essential elements of environment in which man exists, land and water are the basic resources for our existance. These are also the most important resources for the survival of man. These are so intimately related that mismanagement of one leads to deterioration and degradation of others. Mismanagement of land and over-exploitation of vegetation have brought misery and dislocation to millions in many ways. The resultant soil erosion in one form or the other has effected about 140 million hactares of land (45% of total geographical area of the country). The soil erosion in its wake has brought floods, pollution, siltation of lakes, canals and river-beds, reduced crop yields, dislocation of communication, lowering of underground water table, water logging, salinity and variety of other problems leading to a setback to our developing economy.

Soil & Water Conservation attracted the attention of planners right from the first five year plan. With every five year plan the outlay on Soil & Water Conservation increased progressively, so much so that the VI Five year plan envisages an outlay of about Rs. 500 Crores. The expenditure and physical achievements under different plan programmes are given below :

TABLE

Physical achievements & expenditure in Soil And Water Conservation in different plan periods

	Area (Lakh ha.)	*Commulative area in lakh ha.*	*Expenditure Rs. in crores*	*Commulative Rs. in crores*
I Plan	3.00	3.00	1.60	1.60
II Plan	12.73	15.73	20.37	21.27
III Plan	44.95	60.58	77.42	99.39
1966-69	45.68	106.36	86.78	186.17
IV Plan	73.08	179.44	161.13	347.30
V Plan (1974-78)	39.16	218.60	160.77	508.07

The table amply illustrates that investment on soil & water conservation has been increasing progressively over the successive plans. It is a measure of importance that this subject has attained with the passage of time due to over exploitation & deterioration of the three elements of environment viz. Soil, Water & Vegetation.

Soil & Water Conservation is an urgent need of our country for restoring the ecological imbalance in nature & conservation of revewable and non-revewable resources. This programme has assumed such dimensions that various strata of our society needs to be properly educated for effective implementation of massive plan programmes,

Present situation of University education in Soil & Water Conservation in India

Only a few Agricultural Universities have taken-up Soil and Water Conservation as a subject at post graduate level, but these attempts may be called sporadic or half hearted. This subject is not dealt with in its entirety. Soil & Water

Conservation is a multi-disciplinary programme, involving interplay of disciplines like soil science, Agronomy, Forestry, Agrostology, Horticulture, Agricultural Engineering, Hydrology, Meteorology, Sociology and Economics. In the present syllabii of few Agricultural Universities which deal with this subject, only some of the above disciplines are covered-up. which is far from adequate. While the individual disciplines listed above contribute towards, Soil & Water Conservation, it is the multi-disciplinary and integrated approach which is essential for solution of complex problems associated with it.

Contributions of individual disciplines to Soil And Water Conservation.

Soil Science:

Soils determine to a large extent the potential productivity of an area. Problems regarding conservation and Use of Water are also intimately related to different types of soils. For this purpose, Soil Survey is very necessary to identify different soil series and soil types and the uses they can be put to. Further, with the information on nature of soils, land slope and erosion, the soil survey map has to be interpreted in terms of land capabillty classes and sub-classes to determine uses and treatments best suited to actual use of land. This will help in planning maximum sustained yields from such lands without deterioration of the environment. Soil suruey thus serves as a bridge between soil science and technology on the one hand and individual fields on the other.

Agronomy:

Specifications for conservation treatment of agricultural land are based on soil and land characteristics, moisture relationships, climatic influences, economic conditions and needs of farmers. Effectiveness of soil and water conservation measures on agricultural lands, therefore, combines improved agronomic measures and protective measures against erosion hazards. Such protective measures may be contour cropping, contour strip cropping, terrace cropping, cover crops, mulching and residue management.

Forestry, Agrostology and Horticulture:

Lands not suitable for cultivation like marginal lands, gullied and eroded lands and waste lands have to be put under permanent vegetative cover of economic importance, which protects such lands from erosion and helps conserve soil and water. Such permanent vegetative cover to these lands can be provided through establishment of trees, grasses or fruit plants. Soil and Water Conservation on such lands through the use of forest species grasses or fruit plants is a basic part of conservation land use & farm planning. The disciplines of forestry, agrostology and horticulture, apart from being reponsible for plantations on marginal lands, help the farmer in having small farm wood lots, nutritious pasture, well managed grazing ground, small orchards etc., which are economically more paying in terms of fuel, fodder, timber and fruits apart from their social benefits to the community.

Agricultural Engineering:

Conservation farm planning calls for the use of vegetative and tillage practices in combination with engineering measures by way of carefully designed engineering structures for erosion control and water management. Such structures will include water controlling bounds and terraces, farm ponds, improved irrigarion systems and drainage improvement. Grade stabilization structures like check dams of various types to suit different situations are required in reclamation of gullies and ravines. These structures and measures have to be designed properly suiting to the local economic and social conditions.

Hydrology and Meteorology:

The discipline of hydrology encompasses the study of water in its many phases of movement on the surface and within the soil profile and is directly related to the study of rainfall-run-off characteristics, percolation, ground storage and moisture availability to plants. Such a study helps in efficient control and use of rain and irrigation water in a soil and water conservation farm plan.

Sociology and Economics:

In a soil conservation farm plan, land is to be used according to its capability and treated accordingly. As such many prevalent practices of land use and the alternatives have to be evaluated from the point of view of economics. Since, land soil, water, vegetation and people are inter-related, programme of soil & Water Conservation directly affects the life of people. It is, therefore, inevitable that most economic practices suited to people's life and social environment are recommended. Tuus it calls for a fusion of knowledge in both physical and biological sciences with that of social sciences for effective planning and implementation of the programmes under soil & water conservation.

With the above discussion it will be clear that soil and water conservation has to be dealt within its entirety encomassing all the above disciplines in syllabus to the chalked-out for graduate or post graduate studies. Omission of any one of the disciplines will only lead to misconceptions and ultimate failure of these programmes at the national level.

Present Status of trained manpower in Soil & Water Conservation

As has been indicated Soil & Water Conservation has come-up as a massive programme in the five year plans with an eye on creating an impact on national economy and environmental conservation. This programme has very little support, so far as university level education is concerned. However, a base exisis in the country for in service training of personell in soil and water conservation. Central Soil & Water Conservation Research & Training Institute, Dehradun, has been a premier institution in providing such a training to persons deputed by Agriculture, Forest and Soil Conservation departments of the states. Regular training courses and short term orientation courses are being organised at this Institute since 1954-55 to train supervisory and field level technicians. Apart from this, several State Govts., also organise at their own level training of in-service field level technicians.

It is estimated that more than 750 sub-divisions exist in various states with a total of more than 35,000 trained personell to implement programmes in Soil & Water Conservation.

The above infrastructure of trained manpower, has only an insignificant input from universities.

Lack of job opportunities in the field of of Soil and Water Conservation

University level education in Soil and Water Conservation has not been effectively evolved in India because of two main reasons:

(i) Multi-disciplinary nature of soil & water conservation.
(ii) Lack of job opportunities hitherto.

The first point has already been discussed above.

Soil and Water Conservation being a State subject has been a subsidiary programme of Agricultural Departments in India and still it is so in many states.

This actually hindered the creation of job opportunities in this field. In many states soil and water conservation is being looked after by an Additional or Joint Director who functions under the Directorate of Agriculture. Soil & Water Conservation works are also being implemented by Forest Departments. There is however, no seperate cadre of services in Soil & Water Conservation in these States. Situation can be improved by creation of seperate Directorate of Soil & Water Conservation in each State. This is being realised now and some of the States do have seperate Directorate of soil conservation. This will means concentration. of this activity under one agency leading to enhancement of job opportunities for the graduates in Soil and Water Conservaion.

Conclusion

Soil and Water Conservation is one singular activity which has a potential to create a big impact in the field of environmental conservation in India in the near future. University level education in this field has therefore, to be oriented in its entirety. Job opportunities have to be created for personell with higher education in this field by creation of separate Directorates of Soil & Water Conservation of the States, with due emphasis on recruitment of trained manpower in this specialised field of environment research, education and development.

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Rural Higher Education and Environment

R.K. Garg

THE belief that all education is neccessarily good, both for the society or for the individual, and that it will neccessarily lead to progress can be as harmful as it is misplaced. History shows numerous instances where small groups and elites have used education as tool for maintaining their rule and as a tool for maintaing the values upon which it has rested. Continuing in the same spirit National Education Commission (1964-66) stated. . . . . . A system of University education which produces a high proportion of competent professional man power is of great assistance in increasing productivity and promoting economic growth. It is only the right type of education, provided on an adequate scale that can lead to national development ; when these conditions are not satisfied, the opposite effect may result.

There was a drawing realisation that rural India and its needs were largely neglected by Higher Education, with the result that agriculture, animal husbandary and rural life generally continued to be stagnant and backward unaffected by modern scientific and technological development. It was felt that special institutions were needed to prepare personel to man the various services to be organised to run different aspects of the community Development movement.

Linking of education with rural development (recognising work-experience, introduction of job-oriented courses and the suggestion to include Community Development, co-operation, etc., as a part of academics in the Indian Universities) was also emphasized by the committee on Rural Higher Education (Ministry of Education, 1954) and by the Education Commission (1964-66). Thus, the society needs a set of academic programmes with these features :—

(a) Structuring of courses relevant for the rural environment and for the growing development needs of the country. Teaching-research-development training work should all jointly enrich the life of neighbouring areas. It does not imply that the focus of the programmes be so narrow as to delete knowledge about the universe. What this implies that a substantial part of the knowledge should be of revelence to the community with a view to bridge the widening gulf (process of alienation) between the have's and have nots of education.

(b) Work experience at all levels of education as an integral and essential part of the teaching and learning process.

(c) Linking of education with productivity i.e. participation of students in various institutions and activities such as Panchayati Raj, Community Development. Co-operation, Planning and Designing, Fabrication of tools, etc. with emphasis on rural orientation.

(d) While the education is not meant to create jobs, it should nevertheless orient programmes to increase the "employability". This can be obtained in many ways e.g. introducing integrated courses of general and professional education through fullfledged degree/diploma courses, part-time programmes and such other methods to integrate and deepen vocationalisation of sort. In other words formal and non-formal education of a short should be linked through "on the campus" and "off the campus" activities.

(e) Environmental education should form an essential part of degree/diploma curriculm. The curriculam may include a course content of life sciences as well as Social sciences. Thus, it is a teaching programme of multidisplinary approach.

The proposed environmental education paper can be introduced as a qualifying paper at IInd year of the Three Year Degree (T.D.C.) course (all faculties) with the following course content.

Section 'A' Natural Sciences

I. The Environment : Concept : Lithosphere, Hydrosphere, Atmospere, and Biosphere. Their origion, evolution and interaction.

II. Ecosystem : Compotents of a ecosystem. Living and non-living, their interaction and inter-dependence.

III. Soil : Rocks and their types, Soil formations, elements of soil physics and chemistry. Biological components of soil. Soil conservation.

IV. Water : Quality, Physical and Chemical nature of water. Water as a vital resource and its conservation.

V. Energy : Principal energy sources, energy crisis, alternative energy sources and its rational utilisation.

VI. Pollution : Types of pollution. Sources of pollution, its prevention and control.

Section 'B' Social Sciences

I. Population composition and its impact on environment, compromise for survival through political and social relationships, cultural patterns and economic development policies.

II. Human needs and environmental resources :

(a) Man as an agent for environmental changes and new creations.

Rural-Urban. Developed-Developing.

(b) Industrilisation and its impact on rural society.

(c) Rural and urban environment : Socio-economic difference.

(d) Intensification of land use (Forest, Livestock and agricultural productivity).

III. Pollution on land, water, air and anti pollution laws and policy.

IV. Planning for a Quality environment Human cultures and Quality life. Movement towards Conservation.

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Biological Sciences and Environmental Education

C.R. Krishna Murti

ALTHOUGH conservationists have raised their voice of protest, though feebly, throuhgout the saga of human history, yet the genuine concern for our living environment on a global scale began to be felt only after the second world war. The episodes of smoke and smog in London and other cities brought to light the dimensions of air pollution. The ecological imbalance initiated by the spread of chemical pest control agents was dramatised by Rachel Carson in her Silent Spring. The deformities observed in children born to parents who lived through the nightmare of Hiroshima and Nagasaki, the phenomenal growth of industries making inroads into sources of energy, developmental activities for creating new human settlement to increase industrial and agricultural production which in turn involved deforestration and the consequent threat to the survival of rare species of wild animals, plants and birds were events that helped in stirring world wide awareness of the threat to our environment.

The Stockholm Conference on the Human Environment held in 1972 under the auspices of the United Nations Organization provided for the first time an official platform under the umbrella of an International Body for representatives from different parts of the world concerned with the preservattion of our living environment.

Earlier, the International Union for Conservation of Nature and Natural Resources (IUCN), Man and Bio-sphere (MAB) programme initiated by UNESCO and the International Conference on Environmental Future and other agencies had paved the way for identifying problems of environmental pollution, population explosion, the energy crisis, recycling of biological and mineral resources, conservation of water, ecological imbalance, desertification and the possible interference with the course of natural evolution and the adaptation of species by genetic engineering. With the Stockholm declaration and the establishment of the United Nations Environment Programme many of these problems were articulated in a form useful to policy makers for immediate action.

Environment—a multidisciplinary subject

Today there is hardly any field of knowledge that is not directly affected by the "enviromental revolution" (Nicholson, 1971). The long-term dangers associated with the harnessing of nuclear energy are investigated by nuclear physicists along with the discovery and properties of new particles of matter, assessment of man's position in the ecosystem is the meeting point of many physical, biological and earth sciences. Technological innovations are oriented towards the development of pollution-free processes for energy production and consumer industry. Pressure of the rising human population on the dwindling resources of a finite plant is a subject that challenges students of social sciences. The widening gulf between the rich and the poor, the developed and the underdeveloped nations with all the complexities of human problems inherenting such disparities belong to the domain of students of philosophy, ethics and the moral sciences.

Indeed the overwhelming effect of environmental problems on human welfare has rendered the artificial classification of knowledge into humanities and sciences obsolete or at least irrelevant to the present context. There is increasing appreciation all over the world of the fact that an environmental quality commensurate with human welfare cannot be achieved without development, whereas at the same time no conceivable developmental considerations. Hence the urgent requirement for "developing scientifically sound recommendations that can be translated into action in the world of public officials, planners, administrators, etc.—indeed of the whole bevy of creatures that are generally known as decision-makers" (Thacher, 1978). Government leaders and technocrats have now to depend, in their planning process more and more on the skills of those knowledgeable in problems of environment. This underscores the need for the initiation of educational and training programmes to create a pool of a new professional class of generalists and specialists in environmental problems.

From the very nature of problems of the human environment, it is obvious that many scientific disciplines and skills along with social and philosophical studies have to be incorporated into a flexible curricular framework to give a broad based education to create the above cadre. In order to provide the raw material for training at higher levels of education, we must also reorient our primary and secondary education in the school and the undergraduate and graduate programmes in the Universities to bring our children into actual living contact with the environment, with the requisite emphasis on more of outdoor work.

What is Environmental Education

The International Union for the Conservation of Nature and Natural Resources has evolved the following definition of environmental education as an outcome of a conference called by it in Nevada in 1970:

> "Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture and his biophysical surroundings. Environmental education also entails practice in decision-making and self-formulation

of a code of behaviour about issues concerning environmental quality" (Anon, 1970).

Environmental issues such as air or water pollution, the health hazards posed by the diffusion of a toxic chemical, encroachment of cultivable land by dasert etc. begin as scientific problems but eventually demand political or ethical decision. Environmental education should equip decision makers to face such a situation. It is obvious that the current system of lower or higher education is not designed to meet this challenging demand.

Need for Environmental Education

The need for specialist biologists, geologists, geographers, economists and managers will continue to grow in the forseeable future. In order, however, to meet the challenge posed by the peculiar problems outlined above, society will also be needing generalist environmental scientists who can coordinate and interpret data originating from divergent disciplines. "This is vital" as quoted by Coker from a brochure on an environmental degree offered by a British University "if man is to take the necessary steps to halt the current over-exploitation of the earth, and is to attempt to meet the demand of a human population far in excess of ecological balance......it is desirable that a higher proportionation of our politicians and administrators should make environmental science, rather than an arts subject or law, their basic education" (Coker, 1978).

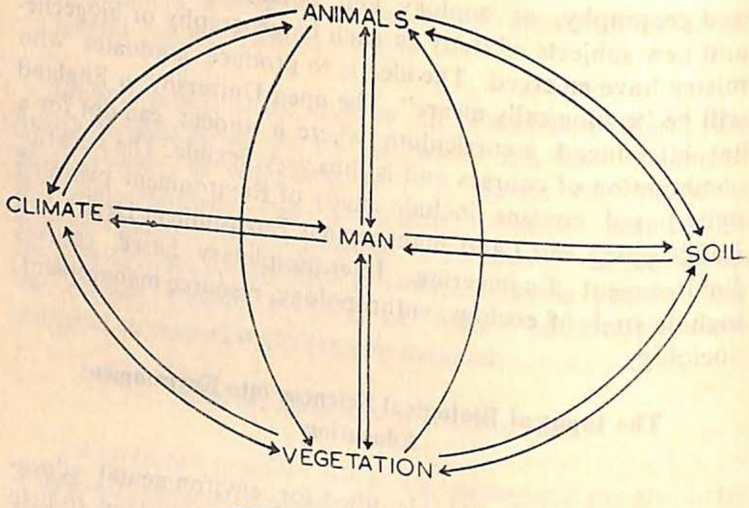
Modules of environmental courses given in the United Kingdom or USA comprise of vocational and interdisciplinary subjects. Vocationally oriented courses include subjects connected to various aspects of the potential career for which the student is trained, they are multidisciplinary in nature and include periods of industrial training during the course. These courses are designed for persons who have already determined their future careers. Interdisciplinary courses embrace a large number of subjects pertinent to environment. The traditional boundaries between such topics as geology and geography, or zoology and botany, have been broken and new subjects of study as such biogeography or biogechemistry have emerged. The idea is to produce graduates who will be "ecologically aware". The open University in England has introduced a curriculum where a student can opt for a combination of courses and is thus very flexible. The vocationally based courses include study of Environment planning Landscaping and Land management. Environment Health and Environment Engineering. Interdisciplinary based courses include study of ecology, anthropology, resource management, sociology.

The Input of Biological Sciences into Environment Education

One of the priorities identified for environmental education of the future is to promote the study of ecology to help in understanding the nature of man's present predicament. The maturing student has to be encouraged to develop a more critical view of the world of which he is a part. This involves the acquisition of extensive and indepth knowledge of the natural and man-made world. Eventually he has to learn the art of making sustainable judgements on what is happening in the world and the formulation of an ethic for the future.

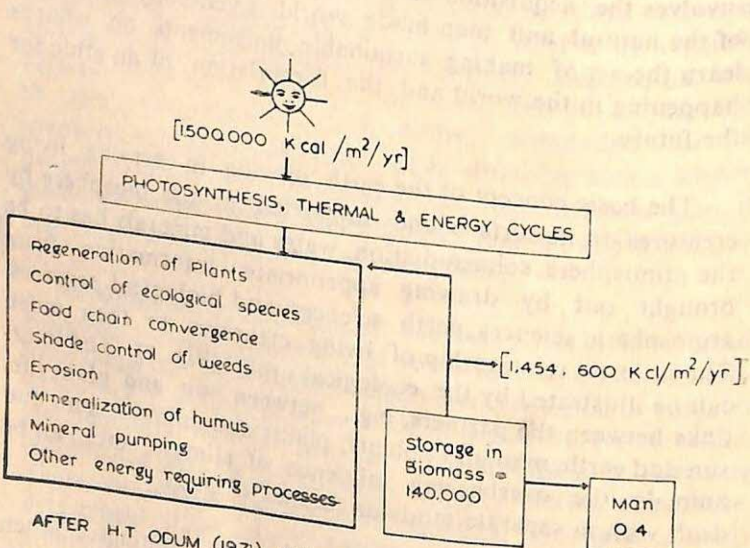
The basic concept of the earth moving in carrying living creatures on its surface and supported in the biosphere by the atmosphere, solar radiation, water and minerals has to be brought out by drawing appropriate information from atmospheric sciences, earth sciences and biological sciences. The intimate relationship of living creatures to their mileu can be illustrated by the ecological cycle (Fig. 1). The interlinks between the partners, e.g., between sun and plant life, sun and earth, man and plants, plants and animals, man and animals, the overbearing influence of climate, etc. can be dealt with in separate modular courses (Fig. 2).

The study of photosynthesis becomes meaningful when it is linked with the possibility of harnessing the sun as an



ECOLOGICAL CYCLE

Fig. 1



AFTER H.T ODUM (1971) ENVIRONMENT, POWER AND SOCIETY. WILEY

Fig. 2

inexhaustible source of energy without problems of pollution. The study of evolution of species must be linked to genetics and the immense potentiality of genetic engineering as a double edged weapon will then become explicit. The study of atmospheric and earth sciences naturally get linked to human ecology when taught with emphasis on the operation of nitrogen, carbon and sulphur cycles, the processes of mineralization both by geological and biological procedures, etc.

The study of insect population in their native habitat, their genetics, natural resistance to disease, survival against hostile environment, plant insect relationship, significance of symbiosis and parasitism in evolution and adaptation should be integrated into a general course on ecology and human health. The ubiquitous nature of biochemical pathways of synthesis and breakdown of biomolecules in living cells, the evolution of homeoestatic control by simple molecules in unicellular and subcellular organisms and plants and relatively complex molecules such as steroids or polypeptides in mammals, the interaction of xenobiotics with living cells and their biotransformation all fall into a natural sequence when the basic aim is to learn the dependence of human health on his internal mileu and external environment.

The integrated approach to the study of life with inputs from the precise tools of mathematics and physics has already paid rich dividends by helping us to quantitate processes and events which hitherto had eluded measurement. However, when you come to the subject of human behaviour as an individual and a member of society and as part of the ecological system, our current knowledge of the underlying forces and factors is almost fragmentary. There has so far been no "breakthrough" in docoding the mechanism of human behaviour. The response elicited in an individual cell to an external stimulus has provided only a very partial answer.

It there a "destructive urge" as argued by some eminent biologists, which with the aggressiveness we have come to associate with the process of survival of species, leads man inspite of moral and ethical forces pulling him back, that drives him towards suicidal plunge? After all, the wanton destruction of our environment, in whatever form one likes to visualize it, is just one form of manifestation of this urge. It is pertinent to remember that molecular explanations for various acts of human behaviour are yet to be enunciated even in the conceptual level. In view of the fact that both physical changes (heat, light and sound) and chemical changes (presence of pollutants even in traces) do cause man to behave abnormally when his capacity for adaptation reaches its limit of tolerance the urgent need to unravel the mechanism of the total behavioural response of man as something more than a mere integration of the various cells and tissues of which he is composed has hardly to be stressed.

The process of environmental education has to be a continuing one based on the known fact that biological systems are dependent on the dynamics of many often mutually conflicting reactions. The limitations of biology as we understand it today are imposed by the concept of evolution, genetic adaptation and control mechanisms based on a central control by transmission of messages through intermediate messengers. Conflicts in existing physical concepts among scientists have not affected the progress of technology since they are in the realm of the "objective world". However, the lack of any solid unified philosophical basis for biological processes such as behaviour has significantly deterred our progress. There should be a "break away" from such conceptual restrictions. Continuing environmental education should aim at evolving new postulates to seek explanations for buman behaviour and its adaptation to meet the present challenge of environmental problems.

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Biology as a Component of Environmental Education

J.S. Rathore

ENVIRONMENT is no longer interpreted in terms of abiotic component only. Environment is a horizon sweeping word and represents the totality of social, biological and physicochemical factors, individually or collectively, that compose the natural and man-made surroundings. Rasul (1979) has classified environment into four basic components—(i) Physical: Water, Air and Land (ii) Biological: Aquatic and Terrestrial flora and fauna (iii) Human uses: Agriculture, Industries, Residential, Forestry, Transportation, Water supply, Navigation, Hydropower, and Recreation (iv) Human values: Traditional life style, religious status, archaeological, economic base, community structure, education, public health, tourism and population character. The term environment, theretore, can cover the whole spectrum of science and humanities. Such a mosaic cannot give any structural and functional insight into the working of environmental systems. Our interest in the study of environment is not merely for a detailed identification of the various components. We are deeply interested in their inter-relations and inter-actions. The target aim is to achieve manipulative skills so that the community of man and the biosphere can be managed effectively. There is a kind of biology, the Environmental Biology, which studies the structure and functions of environmental systems. Other disciplines study the environmental components in isolation but the Environmental Biology explores the inter-action zone of these components. For any convergent and fruitful thinking in the area of environment, the integrating vision of Environment is a must. Since the interacting components of an environmental system are governed by physical, chemical laws and the laws of evolutionary biology, environmental chemistry, environmental physics, heredity and evolution, biological and systemal mathematics and statistics, population biology and socio-economic components are some of the most important ingredients of an environmental education programme. The core discipline, however, will always be the Environmental Biology.

Environmental biology is the environmental science and the appropriate doses of this component at the various levels of biology education on one hand the general education on the other can make the whole educational structure much more meaningful and useful. This component can rightly be called as the 'Human Welfare Component'. Unfortunately, the Indian biology is not alive to the importance of environmental studies and continues to remain static.

Teaching and research in biology have become top priorities for many countries in the Western World. Exciting discoveries at the bio-molecular level and the integrated approach to the biological and non-biological components at the population and community level have transformed biology into one of the most dynamic and creative systems of human enquiry. This fact is amply supported by the number of Noble prizes collected by the biological sciences during the last two decades. Against such a spectacular development of biological sciences in the Westrn countries, Indian biology is finding it very hard to come out of its deep rooted obsessions.

An editorial in *Science & Culture* identifies some of the basic drawbacks of Indian biology. These are, (i) absence of any meaningful compulsory biology course at the school level, (ii) continuity of old descriptive bias in most of our biology syllabi (iii) lack of adequate emphasis on experimental aspects appealing to an intelligent brain and (iv) absence of a pragmatic approach towards a syllabus oriented to the solution of national problems.

The convention of a bi-national conference by the UGC in collaboration with the National Council of Science Education & National Science Foundation of U.S.A. in Bangalore in June 1971, should have triggered a chain of curricular reforms in the university level biology in India. This conference made some very useful suggestions like (i) modification of B. Sc. programme so as to become a broad-based general purpose science degree incorporating a good deal of meaningful biology (ii) integration of botany and zoology departments in order to teach biology in an integrated manner and (iii) achievement of some sort of symbiosis between basic and applied biological research in order to get immediate and distant benefits. The conference identified Environmental Studies as one of the major fields of research in biology which so far remained relatively neglected.

A review of the development of Indian biology from 1971 onwards would reveal that not much has been achieved during these years. The Bangalore conference made a strong plea to make biological science curricula in colleges and universities responsive to the reasonable expectations of scientific scholarship, as well as to those of society and its concerned members. One of the most important steps suggested by this conference was to restructure our most common terminal degree of B. Sc. to prepare citizens to face the problems of daily life in such matters of health, nutrition, population growth, judicious use of energy resources and conservation of natural resources.

Adoption of integrated approach to biology teaching did find enthusiastic support from the UGC which has been instrumental in the creation of few departments of Bioscience in our universities. Shankarnarayan (1971) called it as the beginning of a new era. He viewed this effort as 'breaking the walls at the appropriate places between related departments resulting in the setting up of integrated biological sciences or life sciences. Unfortunately nothing like this has happened. The bioscience departments of our universities, excepting one or two, are still in the search of their identities and are finding it very hard to liberate themselves from their traditional shells. Absence of consensus about the course contents, resistance from traditional botany and zoology departments, callous indifference of State authorities to make use of the products of these departments, parochialism and lack of inter-action with job providing agencies, are some of the most important factors coming in their way to alround progress. Most of the universities nurturing such departments are keeping the nomenclature 'Bioscionce' only as a cover to get appropriate grants from the UGC. We have Sambalpur Universiry awarding M. Sc. in bioscience as 'Plant Stream' and 'Animal Stream' simply to get its products identified for traditional botany and zoology departments. We have Bhopal University creating post-graduate pools in genetics microbiology and limnology under the umbrella of a Bioscience department. These fissiparous trends will defeat the very purpose behind these integrated departments. Environmental biology can contribute a lot to solve the problem of integrated approach to biology. At the cellular level and biomolecular levels all biology is one, structurally and functionally. A cell is just a cell. A DNA chain is just a DNA chain. There is no quesion of *adopting* an intergated approach at these levels. It is only at the level of population, communities and environment, the question of integration becomes important. How to integrate plants, animals and microbes in a meaningful manner? What aspects of plants, animals and microbes deserve special emphasis? How to integrate biological populations and communities with the environment? Is it possible to quantify this integrated system in a mathematical framework so that one can gain predictive insight? Environmental Biology alone can help solving these problems. Thus the unified micro-level and a strong component of Environmental Biology are essential components of any Bioscience syllabus.

Biology curricula of our universities are totally indifferent to the demands of our fast growing society. Fortunately in

India it is not difficult to identify those sections of society which are in urgent need of support from Science and Technology.

A good many people in the rural areas live below the subsistence level." "Science and Technology are the tools which can improve their life." Indian economy is bound to remain primarily agriculture-based for years to come in spite of the present pace and quantum of industrialization. It is pointed out that the environmental, food and energy crisis which the world is facing today, can not be solved in terms of short term answers and remedies. The ultimate answer lies in the judicious use of our biological resources and environment. "Every responsible citizen', 'should have some basic biology education". Referring to the restructuring of biology courses, it is suggested two types of biology syllabi. A rural biology stream would include agriculture, social, conservation and population biology rather than the indoor biology so commonly taught in our universities. In a country like India with a fast increasing population, formal education would become increasingly expensive and beyond the normal resources of the country. Poor people, would need higher education right at their door step. Beginning of post-graduate teaching departments in government and privately run colleges located in remotely situated rural areas has already started. In under-developed States this has become a common practice. The type of biology which we are teaching these days needs fairly good instrumentational support. This is simply beyond the means of these colleges. Rural biology stream can solve this problem in an effective manner.

The above review of the growth of Indian biology during the last decade reveals that if the Indian biology is to gear itself to keep pace wilh the knowledge-growth in the subject on one hand and the needs of Indian society on the other, it must restructure itself in terms of two pools—a fundamental biology pool and a applied biology pool. The courses in the applied biology pool should take into account the needs of a village community. A general B.Sc. degree with appropriate environmental biology component is a must so as to inform an average citizen about the inter-relations of natural environment and a socio-economic system. The man in the street must know that the economic development has its own natural limitations and his concept of life should include restrain and discipline. The 'frog' and 'pea' biology of our higher secondary schools should give way to environmental biology. At the apex level, the applied biology stream should train personnel proficient to tackle the problems of environment, pollution, food and energy. Specific courses can be introduced in the form of short term post-graduate diploma courses or M. Phil courses.

The traditional departments of botany and zoology may put up a plea that their syllabli have already incorporated the environmental component in the form of a course paper in Ecology. Some of the universities have incorporated ecology with other themes like genetics and evolution as one course paper. A complete course paper hardly gets 40 periods of teaching and if it is taught with other themes this number may be much less. Moreover, with the introduction of full-fledged departments of Environmental Biology and Biosciences, the conventional departments should now concentrate more on their core themes.

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10

Coastal zone—Environmental Studies at post-graduate Level

A.G.K. Menon

Introduction

THE zone bordering the coastline of the continents is subjected to a variety of environments and also contains a sizable percentage of the world's population. Industrial, residential and recreational developments and large urban complexes occupy large area of coastal tracts of the highly developed countries. In the near future expansions of many of the under-developed countries will undoubtedly be concentrated in coastal zones. With the rapid advances in technology and with increasing population the importance of coastal areas will assume major dimensions with respect to energy, minerals, transport, food and recreation. Hence there is an urgent need for the inclusion of studies in regard to coastal zone management at the post-graduate level of the Universities in our country.

Coastal zone environment

When considering the coastline for environmental studies it becomes essential to indicate the extensions or boundaries of this zone with particular reference to the pollution hazards consequent to land based human activities. The exact boundaries of the coastal zone in respect of environmental pollution cannot, however, be demarcated. It may not coincide with that accepted either by the geologists or oceanographers. On the other hand, it is affected by quantities of of pollutants discharged, the geology (rock types and soils), velocity of such discharges, velocity of ocean currents and other factors such as tides, storms and waves.

The various environments within the coastal zone area: bays, deltas, sandy beaches, shingle foreshores. lagoons, muddy foreshores, salt marshes, estuaries, rocky foreshores, sand dunes, shingle formations, earth cliffs, rocky cliffs and reclaimed lands. A broad range of conditions is represented by these environments. Some of these areas may be in excess of a hundred metres deep while others may extend several metres above sea level in the form of dunes or cliffs. However, because of their location near the land, coastal environments have large amount of nutrients. The nutrient supply, from the land sources combined with the generally shallow water levels are responsible for the diversity and the magnitude of the faunal and floral populations. Sediments of these areas contain large amounts of watrr often charged with various salts. Gas also occurs in large quantities in various reservoir sands of beach and barrier islands and inner shelf sands. Ancient deltaic sediments act as valuable source beds and reservoirs for a large fraction of the known petroleum resources and coal. Estuarine and salt marshes serve as valuable source of sea food and nursing grounds for several oceanic organisms of great economic importence.

Coastal Zones of India

The coastal zone of India lies within the reorganisation of the seven states : West Bengal, Andhra Pradesh and Tamil Nadu on the east and south and Kerala Karnatak, Maharashtra and Gujrat on the south and west. In addition there are four territories Andaman and Nicobar islands, Goa, Daman and Diu, Lakshadweep and Pondicherry. Together they constitude a coastline of 5680 km and an area of 3,85.000 sq. km. of off-shore where the water depth is within 200 metres.

Legally, the land abutting the sea is under the jurisdiction of the state governments whereas the waters upto a distance 12 km from the land are the territorical waters. India also has the right of a 100 km area for exclusive fishing. Further with the implementation of the 200 nautical miles Exclusive Economic Zone (EEZ) by the Maritime zone Act of January 15, 1977, India gets the exclusive right of exploring and exploiting its living and non-living recources within this area.

Developmental activities

Hydrocarbon exploration:

India has extensive areas of sedimentation in the West Indian Ocean which are considered as potentially rich oil sources. The oil and Natural Gas Commission has carried out surveys in the Gulf of Cambay, Gulf of Kutch, Coromandal Coast, the Krishna and the Godavari deltas and the Sundarbans and have discovered eighteen structural features which are considered geologically favourable for oil exploration. India's first offshore oil exploration was at Aliabett off Cambay. Bombay high which is under exploration and exploitation is located about 12 km north of Bombay. Explorations are also in progress in other areas, nearer inshore namely the Cauvery the Godavari and the Hooghly river basins. It is possible all the other river mouths and wide areas of continental shelf will soon come under the oil exploration. A potential oil well must have on the shore a large complex of supporting anciliary facilities. The oil pipes to carry crude oil to the onshore facilities will have to be laid and the spill containment system developed. The impact of all these would naturally be felt on the coastal zone and the general ecological niches and spawning areas of fishes and other organisms bound to be seriously affected.

Mining:

The extraction of mineral resources of the sea bottom is at present receiving serious attention of the Government of India eventhough no major deposit has yet been reported as a result of the priliminary surveys. When mining of the seabed is started its impact on the coastal zone eventhough unpredictable would naturally be tremendous.

Nuclear and thermal plants:

Setting up nuclear and thermal plants near the coasts is another source of coastal environmental hazard. The Kalpakkam nuclear energy plant situated south of Madras is fast nearing completion. The immediate effects of nuclear plants is on the water environment, creating thermal pollution. Apart from it the large intake of water for cooling the towers will trap large masses of planktonic organisms leading to their total extermination. The fear of redioactive contamination is another danger of setting up nuclear plants.

Fisheries:

Our marine fishery is fast expanding and soon our expertise is bound to reach a stage of exploiting the living resources up to the 200 miles Exclusive Economic Zone. This vast expansion of our fishery will naturally necessitate development of onshore facilities for processing in a big way thereby creating a congestion and possible rivalry with other industries sucn as shipping and the oil industry.

Coastal aquaculture:

Another industry where interest with oil and shipping industry will clash is coastal acquaculture. The expanding demand and high prices of prawns prevailing in the foreign markets to-day have already prompted industrialists in our country to start fish farms along the coastal zone especially near the estuaries, creeks and lagoons.

Deep water ports:

To relieve congested ports like Bombay, Cochin and Madras, we will soon have to establish deep water ports to handle container cargo and other large tonnage ships. This would envisage increase in small craft traffic, onshore supply facilities and housing and other complexes for personnel.

Dumping:

At present there is limited dumping in our off-shore waters. Dumping is the disposal of any type of waste including nuclear waste in the coastal waters. India will have to seriously consider the problem of waste disposal and control the disposal of domestic waste into the sea and maintain strict security measures against international dumping in our waters.

Marine Parks:

Practically no consideration has so far has been given to the problems of conservation of marine environments of our coastline. There is an urgent need for the establishment of marine parks and reserves in suitable areas for scientific research, recreation and tourism development. Sand dunes, Coral reefs. estuaries, mangroves, sea grass beds, beaches and other such coastal hobitats play a very important role not only in keeping the ecological balance of the land and the adjacent sea but prevent large scale erosion of the coastline. It is therefore essential that representative areas of the ecosystems are protected through establishment of marine parks and reserves.

Management Regulations

Investigations mainly of a geological and engineering nature, are to be intensified along the Indian coast to locate the oil and mineral resources. The extraction of oil and mineral should then be properly regulated through proper legislation with regard to the grant of leases and measures to be followed for environmental protection. This envisages a thorough environmental impact study on the part of the industry and an act requiring such a precautionary/preventive safety measures may be formulated by the Government to enable it to issue the necessary licenses.

With regard to management regulation of renewable resources such as fishery, Regional Management Fishery Councils will have to be set up rather than individual state councils. It will be better that the coastal states take the overall interest of the nation in considering comprehensive plan to tackel the management and development problems of the 200 miles Exclusive Zone.

The coastal zone management programme is of crucial importance. A system of zoning in which a certain area is set aside for a particular major use and others given over to multiple use should be adopted. Strict maintenance of some stretches of the coastline in a natural state exclusively for conservation of habitats should also receive careful attention. Categorisation of activities should thus be evolved in such a way that contrasting use of the coastal zone at any point is avoided.

A national policy on coastal zone management should be formulated by a multidisciplinary team. The same team could constitute a coastal management Task Force to formulate the policy to preserve, or restore the coastal zone effectively.

Conclusion

The present day science education in Indian Universities concerns itself mainly with subjects like Physics, Chemistry mathematics, Social sciences, Engineering and life sciences with separate departments of their own. It is high time we break down the walls of the traditional departments to establish in every university in India a separate department of environmental science to impart education and conduct research in areas of natural resources and environmental problems. The use of our non-renewable natural resources, like minerals and oil brings about a number of problems of environmental pollution and degradation. Our Universities should develop curricula for post-graduate studies on man's impact on his environment especially the coastal zone environment which is the nursery for all the living recources of the sea.

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Environmental Education in Universities

M.V. Pylee

THE phenomenal growth of science and technology has not been an unmixed blessing. The developed countries whose standards of life and extent of progress have been measured on the basis of their achievements in the field of industrialisation are now much concerned by the evil consequences of such development. Such consequencs have already had their serious impact on the social, cultural and health aspects of these societies. Among these perhaps the most serious is related to the environmental aspects.

Industrial revolution had indeed brought about an economic, social and cultural revolution in several nations, especially of the West, during the last three centuries. But at the same time the incalculable harm it was bringing about to the environment as a whole and the damage that it was doing to the life of the community at large and even to our planet earth as a whole, has not been noticed or its seriousness properly understood even by knowledgeable people like scientists and technologists until recently. It is only during the last one decade or two, this problem has been attracting widespread attention. The tragedy is that when developed countries face the problem after having achieved great strides in industrialisation and modernisation, in the underdeveloped countries they face it even before they have made a reasonable measure of progress in industrialisation and modernisation.

The United Nations Conference on Human Environment in Stockholm in 1972 marks perhaps the first systematic attempt to grapple with the problem of Environment. This was followed by the International Workshop on Environmental Education held in Belgrade in 1975. The workshop formulated the guiding principles to achieve the objectives of the Stockholm Conference. In 1977 an Inter Governmental Conference on Environmental Education was held in Tbilisi, capital of the Georgian Republic of the USSR. This Conference which was held under the Joint auspices of the UNESCO and UNEP followed closely in the foot steps of the Belgrade Workshop was indeed the most significant land mark so far in formulating the objectives of environmental edcuation, especially at the university level.

Considering that universities—as centres for research, teaching, and training of qualified personnel for the nation—must be increasingly available to undertake research concerning enironmental education and to train experts in formal and non-formal education and that environmental education in colleges and universities will become increasingly different from traditional education and will teach students essential basic knowledge for work in their future profession, which will benefit their environment the Tbilisi Conference (1977) made the following recommendations to Member States:

—to review the present potential of the universities for conducting research, especially fundamental research, concerning environmental education;

—to encourage acceptance of the fact that, besides subject-oriented environmental eudcation, interdisciplinary treatment of the basic problems of the relationships between people and their environment is necessary for students in all fields, not only natural and technical sciences but also social sciences and arts, because the relationships between nature, technology and society mark and determine the development of a society;

- —to develop different teaching aids and text books on the theoretical bases of environmental protection for all special fields to be written by leading scientists as soon as possible;
- —to develop close cooperation between different university institutions (departments, faculties, etc.) with specific objective of training experts in environmental education;
- —such cooperation might aseume different forms in line with the structure of university education in each country but should combine contributions from physics, chemistry, biology, ecology, geography, socio-economic studies, ethics, educational sciences and aesthetic education etc."

It is with this background in view that the university of Cochin perceives the need for a school of Environmental studies. With its special emphasis on Science and Technology, Industry and Commerce, the University has to make its contribution to the economic development of the State through science, technology and management. In the same context, it also envisages to contribute to the balanced use of science and technology not only to solve the problems of environmental deterioration where they have already appeared but also to design appropriate preventive measures during the course of development activities.

Aims and objectives of the School of Environmental Studies

The objective of the School of Environmental Studies is to develop a general awareness regarding the environmental problems and to educate the administration, industries and public the principles of environmental protection and management on the one hand and to create a group of specialists in different areas of environmental study such as environmental sciences, environmental law and environmental management on the other. In ordor to realise these objectives the following activities are proposed:

1. To organise and support research programmes in different disciplines relating to the envionment as well as specific problems pertaining to the environment
2. To collect, prepare and maintain an up to date data bank and information system on environmental impact reports for the benefit of the industry, commerce and the government.
3. To disseminate information on environmental matters; by way of extension programmes; seminars/symposia/workshops, publications, etc.
4. To conduct courses of study leading to the award of postgraduate certificate, diploma and degree as well as research degree.

The proposal for setting up a School of Environmental Studies in the University of Cochin offering academic programmes on an interdisciplinary basis was subjected to careful study by a Task Force which was specially appointed for this purpose. The Task Force felt that the basic approrch to the study should be interdisciplinary. The Task Force also felt that this interdisciplinary concept was indispensible in designing any programme of study on environment. Several disciplines such as Physics, chemistry, biology, engineering. medicine, management, etc. are directly connected and relevant to the study of any environmental problem'.

The Public Health Engineering Research Institute presently redesignated as National Environmental Engineering Research Institute (NEERI) with headquarters at Nagpur with its zonal centres spread over the country has been organised in its present form for tackling environmental problems of which Cochin has zonal centre. However, NEERI does not offer any regular academic programme. It is concerned more with research, field work and collection of data regarding environmental pollution and finding practical solutions to such problems. A close collaboration with this Centre in Cochin is planned for developing the School of Environmental Studies in the University.

Proposed activities of the School of Environmental Studies

The School of Enviromental Studies envisages the handling of different basic disciplines, the transdisciplinary activity of which is expected to converge on a central theme, namely, management and protection of the environment. Considering the multidisciplinary nature of the programme in the School, the Task Force felt that a separate Faculty of Environmental Studies should be created in university. Under the Faculty of Environmental Studies, the following academic programmes are to be offered.

Teaching programme

The curriculum formulated for the teaching programmes may cover topics which have direct relevance to the environmental problems. The teaching programme is planned to be offered in three forms; a postgraduate certificate course; a postgraduate diploma course or a post-graduate degree course based on the depth of study. Provision for multistage entry to different courses could be made for the benefit of the participants. The admission to each coursc is restricted by a well defined system of entrance tests. The teaching programme may be offered either as a one semester full time one or a two semester part time certificate course, a two semester full time or four semester part time diploma course or a four semester full time or six semester part time degree course. Weightage will be given to those who have successfull undergone the certificate or diploma courses for admission to the degree course.

The Task Force was of the opinion that to begin with only part-time teaching programme need be taken up, the admissions being open to persons possessing a degree either in engineering, medicine, agriculture or veterinary science or a postgraduate degree in any of the science subjects working preferably in Public Health Engineering Department, Greater Cochin Development Authority, City Improvement and Town Planning Trusts, Agriculture and Animal Husbandary Departments, Industrial Concerns, Factories, Local Bodies, University and College teaching Departments and the like. The number of academic years spent successfully for university education is taken as one of the criteria for equating postgraduates in science subjects with graduates in engineering, medicine, etc. This approach of admitting employed persons to different courses in Environmental Studies is expected to create a demand for trained environmentalists in various organisations at different levels. Having thus prepared the ground for the position of environmentalists at different organisational levels, the School might start offering teaching programmes on full time basis for the benefit of fresh candidates whose job potential is expected to be bright. The move for a Central Legislation towards the protection of environment may ably supplement the demand for trained environmentalists.

In additoin to these courses, short term courses leading to the award of certificate or diploma on specific topics such as Industrial medicine, occupational hygiene are also to be offered as and when required.

Research programme

Simultaneous with the teaching programmes, emphasis should be placed on research projects as well. The University expects financial support for such projects fr om funding agencies such as the University Grants Commission, Council of Scientific and Industrial Research, Indian Council of Agriculture Research, Science and Technology Department of the Government of India, the concerned Departments of the State and Central Governments, WHO, UNIDO, UNDP and other International agencies.

Individual research workers are to be encouraged to work on specific programmes which may ultimately lead to the award of Ph. D. or D. Sc degree. When compared to other organisations, the University of Cochin provides only a small number of scholarships. The Task Force has recommended that the scholarship amount be enhanced and their number be increased to attract competent research workers. However, to start with our proposal is to institute four university junior fellowships and a senior fellowship under the faculty of Environmental Sludies.

Comprehensive research programmes in the following areas have also been identified.

I. Environmental impact of air, water and land in and around the Hindustan Newsprint factory at Velloor, Udyogamandal area where a number of chemical factories are located, Ambalamedu area (FACT Cochin Division), Sewage treatment plant in Greater Cochin Area, Cochin Shipyard, Mavoor Rayons, Calicut, Titanium products.Trivandrnm, Fish canning centres, retting grounds etc.

II. Environmental changes in the Kuttanadu region consequent on the constructicn of Thannermukhom Bund

III. Problems created by aquatic weeds and their control

IV. Recovery and refuse of waste products from Agriculture, Horticulture and Animal Husbandary projects.

Extension programme

The basic objective of the extension programme is the dissemination of the awareness about the environmental problems and dissemination of the knowledge about the environmental pollution and their solutions, assessment of natural resources and their judicious utilisation, civic responsibilities etc. For this, seminars. symposia or workshops are to be organised at different levels (urban, rural, district, different industries etc.) from time to time. Such seminars etc. are to be organised with the help and cooperation of local authorities, of the industrial concerns, managers and workers of various industries etc. These programmes are to be followed by research projects to study in depth the specific problems confronting a particular area of industry. Audio-visual programmes concerning environmental deterioration, protection and conservation may also be taken up for publicity.

Under the extension programme, it is also proposed to adopt a village or a division in the Greater Cochin Development Authority area as a model to demonstrate how developmental activities could be taken up without hazard to the environment.

The Task Force has recognised the pressing need for faculty development for the successful conduct of the various programmes. But this can be achieved only stage by stage. Until such time, the services of qualified persons working in scientific institutions or industries will be made use of either on a part time basis or as guest lecturers or visiting professors.

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Environmental Education at Post Graduate and Higher Level

P.V. Bhiravamurty

Introduction

AS A RESULT of man's interaction with nature on a large scale, the nature's balance have been upset and environmental decadence occurred in most parts of the world. It could be either a result of improper and unscientific exploitation of natural resources or due to environmental pollution. This has posed a serious problem to the very existence of man, plant and animal life on this planet earth, threatening not only the quality of man's life but also his very survival. For the foreseable future, among the most significant areas of continuing concern in India, as in the whole world, will be man's relationship to his environments—human and physical. Central to this concern is the need, not only to increase our awareness and understanding of those environments and man's impact upon them, but also to find more effective ways of managing them. For a better management and conservation we need to understand and analyse the problem from micro to macro environments. It is now essential, therefore, to consider the environment and its management as a discipline by itself. To achieve this goal, environmental education is the need of the day and it should be designed to develop professional and scholarly competence in understanding and dealing with the environments in which the people live and with the purpose to discover, assemble, integrate and disseminate knowledge towards resolution of environmental problems for the enhancement of human life and a more livable future for us all. For fullfilling these objectives a programme of interdisciplinary studies in an integrated fashion, bringing together the disciplines of biological, physical and social sciences, has to be established not only at the University level but also at the primary and the high school levels.

Course Content

The aim of the Environmental Science programme is to equip students of widely differing backgrounds, the opportunity of widening their knowledge of environmental problems, to identify the same and to arrive at more effective ways of solving them. The course content has to be based on the major environmental systems such as atmosphere (meteorology), lithosphere (geology), hydrosphere (hydrology), biosphere (ecology), the interactions between these systems (biometerology and soil science) and the aspects of management, manipulation and the alterations of these systems by man (eg. planning, conservation, water resources studies).

For a meaningful training of the students in various aspects of the environment a full time 3-year M.Sc. (Tech.) Degree course is to be started.

The duration of the course will be spread over three years and each year will have two semesters. In each semester a student can take 4 or 5 courses at least in the first two or three semesters. Taking of 5 courses per semester is a meaningful one so that the students admitted with different backgrounds can finish the orientation courses during this period, such as biology for non-biology students and physical sciences/Mathematics for biology students. This will help solving the problem of teaching biology to non-biology students and mathematics for biology students.

At the end of each semester the students should be assessed in theory, practical/field work and viva-voce by way of marking or grading system.

Project work/dissertation topic is to be chosen by the student at the beginning of the third year (i.e. 5th semester). This will enable him to work on the problem in greater detail for full one year utilising his time both in the library and field for the collection of the data.

Elective courses are to be chosen by the students at the beginning of the 6th semester. However the choice depends upon the number of students and the number of Electives offerred.

A teacher should be assigned to teach a single course during a semester. Student counselling can be done by all the staff members. One or more students can be assigned to a staff member. This will be useful to resolve the problems (academic/personal) confronting the students. It is better that the staff teachning various courses of M. Sc. (Tech.) should be appointed and attached to the department of Environmental Sciences but not to the parent departments.

The course content, teachning and examining methods have to be discussed and formulated by the respective Boards of studies.

To achieve the objectives of the degree as a whole, and of each course, a wide variety of teaching methods are to be employed. These should range from formal lecture session to discussion groups, seminars, field work and individual projects. By these, it will be possible to recognise competence of the students and for a fair assessment.

In the lectures audiovisual aids, such as slides, films, television, video tapes are to be used. Each course may have 3 lectures per week and 3 hours for practical or field work. Seminars of 1 or 2 hours involving one or more staff members are to be organised. One or more students will give an introductory talk followed by discussion in which both staff and students participate. These seminars will be useful for interdisciplinary or multi-disciplinary topics. Tutorials of one hour duration can be taken up by the lecturer who teaches the course. Students may be taken up by the lecturer who teaches the course. Students may be asked to write essays which will be marked by the teacher. This will help in discussion, to develop literary talent and clarity of thought. Exchange of students and faculty are to be made possible with other institutions. The student should have a sufficient background in the field of study to be taken up by him at the host institute. Exchange programmes of teachers to other Universites in India and other countries where work on Environmental problems is activily going on, for a period of six months to one year will be essential to acquaint with modern trends.

Professionals have to be brought from other institutions to provide lectures or seminars. Outside participation provides a chance for closer contacts and fruitful discussions on the problems.

Library and Text Books

Adequate library with appropriate literature, proper text books, laboratory manuals and journals etc. should be made available. Writing up of text books and laboratory manuals suitable for our needs should be encouraged and developed.

Assessment

The basic aim of the course is to judge a wider spectrum of different attainments and abilities of a student than by traditional systems. Students are to be assessed by about 30 percent internal valuation (continuous evaluation) and 70 percent internal and external valuation. Internal assessment lessen the examination tensions and will benefit the consistent and industrious student who may not work well under time stress.

Research

All members of the teaching staff rhould be actively engaged in research. The laboratories are to be well equipped for this purpose with facilities such as photographic equipment, constant temperature and cold rooms, greenhouses, an animal house, aquaria for fresh and sea waters, controlled environmental plant animal growth cabinets, motor vehicles for field trips. soil core samplers, air and water pollution monitoring equipment, computer etc. Efforts should be made to buildup coordinated multidisciplinary research teams and problems should be relevant to local environments and such problems as air, water and soil pollution, marine and terrestrial ecosystemsand their management, wild life, range, grassland and water shed management, agriculture and land-use management, urban and rural development (planning). A three year Ph.D. programme or one/two year M. Phil programme should be oriented.

Adequate funds are essential for research as well as study programmes of interdisciplinary natures. The University Grants Commission, Industrial Organisations, Department of Science and Technology, Urban Development Authorities should support these programmes.

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Environmental Studies—in Indian University

Shridhar C. Gupta

Introduction

THE BASIC need for conducting studies in the environmental sciences cannot be overemphasized. The subject itself is very wide as can be seen from the definition given in the report of the National Science Board of the National Science Foundation, U.S.A. It states that this subject covers "the study of all systems of air, land, water, energy, and life that surround man. It includes all sciences directed to the system-level of understanding of the environment, drawing especially upon such disciplines as meteorology, geophysics, oceanography, and ecology, and utilizing to the fullest knowledge and techniques developed in such fields as physics, chemistry, biology, mathematics and engineering... Environmental systems contain the complex processes that must be mastered in the solution of such human problems as the maintenance of renewable resources (water, timber, fish), the conservation of non-renewable resources (fuels, metals, species), reducing the effects of natural disasters (earthquakes, tornadoes, floods), alleviating chronic damage (erosion, drought, subsidence), abating pollution by Man (smoke, pesticides, sewage), and coping with natural pollution (allergents, volcanic dust, electromagnetic noise.)" As emphasized by Strahler and

Strahler (1973) it is difficult for any single institution to undertake studies which would include all the aspects covered by this definition. The objectives of the Indian Universities should be to study those aspects of environmental sciences which have the direct bearing on society both urban and rural.

A completely natural environment cannot be expected to be present in a highly populated country like India. Over the centuries it has been radically changed due to the activities of man. The changes have been especially rapid with the industrialisation of the nation and movement of the population to urban centres. The work of various scientists in the field of environmental sciences has clearly demonstrated that the deterioration in environment is related to the consumption rate which in turn is directly proportional to the level of economic development and growth of population. The relationship between economic development and environmental quality has been brought out by the studies of Cumberland (1972 and 1977).

Need for Studies in Environmental Sciences

The success of environmental planning will be dependent on the awareness of environmental problems and the need for conservation of the natural environment which has to be inculcated in the rural and urban masses. This can be achieved through the introduction of courses in environmental studies at different levels of University education and by the introduction of research programmes in the University Departments. This would facilitate the diffusion of knowledge through the media of students and teachers. With this in view the University of Poona has formulated a programme of research and development with a rural bias (Bhiday et al 1979). The main aspects of this programme including those under the auspices of the School of Environmental Studies are given below:

(a) Effective harnessing and utilisation of energy.

(b) Development of local materials for rural industry.

(c) Bio-medical awareness and solutions of health problems.

(d) Improvement and understanding of environmental conditions and eco-system, and finally,

(e) Adoption of modern techniques for 'distance teaching to disseminate scientific information and knowledge connected with all the above mentioned facts, in the language that the rural population understands.

Programmes under the School of Environmental Studies

A coordinated research programme in environmental studies is proposed with the following objectives:

(i) Evaluation of the various parameters constituting the eco-system in the uplands of western Maharashtra.

(ii) Identification of problems requiring immediate attention, especially those relevant to day-to-day needs.

(iii) Development and fabrication of cheap techno-system which could be used for monitoring and improving the eco-system.

Four areas representing different geographic and economic setting have been chosen for pilot studies. These are :

(i) The Poona Metropolitan area.

(ii) The area around Mulshi, south west of Poona,

(iii) The Shivganga basin south of Poona, and

(iv) The drought-prone Saswad area to the southeast of Poona.

Investigations pertaining to the following projects will be undertaken in the above-mentioned pilot areas:

(i) Study of the geographical and geological parameters in the eco-system.

(ii) Evaluation of the bio-system with special reference to the botanical pollutants.

(iii) Study of water balance and water management

(iv) Study of the impact of changing eco-system on socio-economic structure

(v) Development of anti-pollutants and conservation devices.

(vi) Development of optical and electronic systems for monitoring the eco-system.

The basic step in the implementation of the research programmes would include the study of the various geological and geographical parameters and the identification of specific problems related to spatial variation in these Parameters. A spatial analysis of the various ecological factors and their relationship with the existing use of land will have to be considered as a pre-requisite for identification of problems and remedial measures. The investigations to be undertaken, therefore, include:

Morphometric and climatic analysis of the sample areas selected for study: The slope characteristic of the land and their relation to the optimum use of resources will have to be studied in detail for any planning of reform in land utilization. The three sample areas selected for study are representative of three different types of climates in this part of the country. An analysis of the climatic differences based on the study of rainfall regimes, the temperature regimes wind velocities and relative humidity will be studied at micro level associated with the different geomorphic conditions. Considerable amount of data collection in the field from a number of weather stations to be located in the sample area will be necessary and the work will be essentially carried out by geographers and climatologists.

(ii) *Study of land use agricultural patterns and industrial development*: For planning the future developments in agricultural and small industrial sector in the rural areas, an appreciation of spatial distribution of the present land use and its correlation with the variations in the geographical conditions is essential. A detailed study of land use with regard to agriculture, forestry and other types of primary uses as well as the consequent secondary uses of land will be undertaken in this programme. The details of this phase will be worked out by agronomist, botanist and geographers associated with the school.

(iii) *Geological mapping and geohydrological investigations*: An intensive study of the variations in geological and geohydrological conditions in the sample area will be necessary for understanding the morphometric variations as well as the variations in soils. This part of the programme will be mainly carried out by geologists and geophysicists using sophisticated modern equipment for ground water prospecting, bringing out clearly the variations in water table and spatial variations in the potentiality for the supply of well-water for various purposes.

(iv) *Surveys of the bio-systems and edaphic conditions*: In view of the significance of bio-systems and soils in the effective utilization of the land, evaluation of the potential for the growth of various species and the variations in productivity of soil will be undertaken. The approach for development in this regard will be based on economic-ecological studies of various types of plant life, animal life and micro-organisms.

Variations in soil conditions at micro level will be studied with reference to their impact on the variation in land use. This part of the study will be useful in identifying the suitable species with an emphasis on certain types which are generally considered as environmental hazards, but may have a considerable potential to become a resource for development, such as water hycinth, algae and organic waste from agriculture. This programme will be developed and undertaken by a team of botanists, zoologists, and soil scientists.

(v) *Analysis of air, water and soil pollution*: The problems of air, wind and soil pollution arising out of the application of modern technology will be studied under this programme. The emphasis here will be on the water and soil pollution which are recognised, as basis hazards in the development process affecting the productivity of land and the efficiency of labour. Contaminated water is a probldm haunting the villages for a very long time, adversely affecting the health and efficiency of the available labour. The pollution is mainly related to the lack of sanitation facilities and causes a number of diseases. The soil pollution is related to the use of fertilizers as well as to the lack of effective control of soil erosion and spread of weeds. Uuder this programme, the various factors affecting such pollution may be studied by a team of chemists, biochemists, microbiologists and botanists. The study will be restricted to samples selected from the three areas covered by this programme.

These studies will be based largely on field work and will be aimed at evaluating the factors responsible for the slow rate of rural development. These programmes can lead to a proper understanding of aereal variance in the potential for growth and for devising remedial measures in this regard.

The large scale occurrence of bio-pollutants like water-hycinth, in western Maharashtra poses a serious problem and immediate investigations are necessary in this regard. The programmes included will be:

(i) *Identification of the bio-pollutants and the spatial variations in their occurence in the sample areas*: This study will be based on collection of samples in the field and will be directed at the identification of the significant bio-pollutant. A considerable amount of laboratory analysis will be done for estimating the level of pollutions in different parts of the sample area. This will involve zoologists, micro-biologists, chemists and experts in medicine contributing to the development of the entire programme.

(ii) *Search for measures to control, irradicate or to find the use of such pollutants*: This programme will be mainly carried out in laboratories after the identification of the pollutants and a study of the spatial variation in the level of pollution in the region. Efforts will be made to develop techniques for effective utilisation of some of the pollutants especially for the improvement of environment. Similarly, techniques for their control and/or erradication will also be developed. This will be based on results from (i) above. Development and techniqeus for the use of waste especially in the study areas will be made under this scheme. This aspect will be considered in collaboration with other schools viz., Energy School and School of Material Sciences. The morphometric analysis and the studies carried out under 6.4 will provide a basis for planning a diffusion of such techniques in the area.

Rapid industrialisation, increase in the area of land under cultivation, changes in agricultural patterns, and climatic changes resulting from deforestation etc have adversely affected the water balance, making conditions in some drought-prone areas, like the Saswad area chosen for model studies, very critical. It is, therefore, necessary to not only augment the water supply by tapping all surface-water and groundwater sources but also to frame a water management policy allowing optimum utilization of available water. The proposed pilot studies in the three areas mentioned above will include:

(a) Morphometric analysis of the drainage basines; and calculation of amounts of infiltration and run-off.

(b) Field studies leading to the preparation of water-table maps, and estimation of ground-water resources.

(c) Survey and selection of suitable sites for wells (both bore and dug wells) and small scale civil engineering works like percolation tanks, bunds and earthen dams.

(d) Calculation of total quantity of water available every year, estimation of water requirements for agriculture and industry, and framing of water management policy.

During the last few decades the ecological system in western Maharashtra has undergone pronounced changes as a result of industrialization, deforestation and changes in the agricultural patterns. At the same time these factors have also brought about changes in the socio-economic framework. It is necessary to evaluate quantitatively the extent of the socio-economic changes and correlate them with changes in the eco-system. The programme of research in this direction will be drawn up in consultation with research workers in the Faculty of Mental, Moral and Social Sciences, after preliminary results of the projects covered by the School of Energy Studies, the School of Materials Science, and School for Bio-Medical Studies are available. These studies will be useful in developing the scheme for diffusion of the information regarding the existing conditions of physical environment and for developing an awareness of the need for management and proper utilization of the ecosystem. The acceptance of the remedial measures by the population in the rural areas will be related to the social-economic conditions in the area, and hence, proper methods of communications will have to be developed in collaboration with the School of Mass Communication. The details of this scheme will be worked out after the social scientists provide the information regarding the impact of changing eco-system in the socio-economic structure of the region.

Within the overall scheme outlined above the following project involving environmental studies has been initiated during the current (1979-80) academic year.

A study of pollution in the Pune Metropolitan Area-Phase 1

Study of Water pollution: Rapid industrialization in the Pune region has resulted in massive deterioration in the quality of water-surface and underground-available for human consumption. It is absolutely essential that we expeditiously assess not only the nature and extent of pollution but also devise remedial measures to overcome this pollution. With this objective in view, the following programme involving a study of water pollution in the Poona Metropolitan area has been undertaken.

- (i) Geological (including Geohydrogical) and Geomorphological mapping of the area to assertain the characteristics of the bedrock, particularly their water transmissibility.
- (ii) Systematic sampling of water at carefully selected stations in regions known to be polluted by industrial effluents and sewage systems, as also in area thought to be relatively unpolluted.
- (iii) Analyses of water for various physical, chemical and microbiological parameters.
- (iv) Identification and quantitative assessment of various types of toxic elements

(v) .Demarcation of areas of high pollution, and

(vi) Devising of suitable remedial measures.

The project is being undertaken jointly by the staff members of the Departments of Geography, Geology Chemistry, Physics, Botany, Zoology and Microbiology. Some students of M. Phil. of these Departments are also associated with the project.

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14

A Futuristic Outlook on the Environmental Education in Our Universities

A.R. Zafar

THE PAPER focusses attention on the shortcomings of the present pattern of environmental education, training and research in our colleges and universities.

However simple it may look apparently, any problem of resource or environmental management is too challenging to be tackled by an individual. Only a coordinated effort of a team of researchers could produce tangible results. Not that this is a novel idea still awaiting trial in our country. Attempts have been made in the recent past to organise coordinated research in several fields of technology through a chain of laboratories set up by CSIR and other competant agencies. What has been achieved in this complicated field, is beyond me to assess but one thing is certain that it has not brought about an interaction between the universities and these laboratories. Probably the fault lies neither with the individuals, nor with the research laboratories, nor with the universities, but with the entire setup. Since our primary concern at the moment is education, let us discuss the pattern of university education in this context.

The present system of our university education is basically discipline-oriented i.e., we teach a subject for subject's sake.

Of late, under the pressure of ever-increasing unemployment, we are drifting towards an education which could at the best be called job-oriented. We have yet to evolve a system which imparts problem-oriented education and conducts problem-oriented research. Again, our educational pattern is designed to reward individuals in terms of degrees or diplomas. Thereby the goal of a student entering into a university is to achieve distinction in the examination or to obtain a prestigeous degree like Ph. D. Consequently even the best of our doctoral dissertations, though of great academic or applied value, are by and large isolated pieces of work. The logical wayout to this enigma is probably to introduce a system wherein degrees are awared to a team of researchers who have worked together to produce data on all aspects of a single problem. The field of environmental sciences is particularly suitable for such a coordinated work and cooperative dissertations. This does not necessarily mean the abolition of present system of independent work and individual rewards, since both the systems can coexist.

With a slight deviation the idea of problem-oriented education could also be extended to the teaching of specialised courses at post-graduate level. The present day practice of offering an advance course with the help of specialists attached to the faculty is rather outdated. It dulls the students and the teachers both. It gives rise to isolated thinking and narrow down the scope of training because the curricula, even if modified frequently, are to be framed keeping in view the limited number of specialists on faculty staff on one hand and the limitations of the laboratory facilities on the other. The universities should evolve a system where the teaching of advance level courses involves not only teachers from different faculties but also experts from outside the university— say industries, research laboratories, etc. etc. To bring about inter-faculty coordination in teaching is the internal affair of a university and can be achieved with slight administrative adjustment. However, the involvement of extra-faculty experts. cooperation of the industries, research laboratories and pertinent government departments will have to be sought. Such experts may be given the status of honorary members of the relevent faculty. It should not be difficult to find suitable experts agreeing to teach since psychologically every knowledgeable person has an inner urge to teach and every town in India where a university functions is developed enough to engage number of experts in various fields of human activity. This proposition is neither costly nor novel. Our hospitals and medical colleges utilise the services of expert physicians and surgeons who are not on their regular staff. Similarly prominent lawyers are invited to teach in some of the law faculties. If such a pattern is practicable in professional institutions it should equally be successful in teaching of arts, science and commerce in general and environmental sciences in particular.

A very important function of education is to popularise the factual information. The environmental educators have also to bear this responsibility. One need hardly mention the fact that our rural environment is inherently polluted with dust and filth. In this context it is often argued that poverty and filth go together. This implies that unless poverty is removed filth cannot be removed. I beg to say that is only half-truth. From environmental view point a clean morum road is superior to a filthy cement road; a clean tiled hutment to an ill maintained cement-concrete house; and, an open-air theatre to a cosy air-conditioned theatre. What, therefore, is required is the "reorganization of village living from environmental view point" prior to or along with its economic development. Even the literate populace, leave aside the rural masses, is not conscious of this since, in the last thirty years, economic development aspect is so projected that it has overshadowed every other aspect of development. Per-capita income and its meticulous comparisons with the technologically advanced countries has ruled supreme in our thinking. It has obliviated the importance of purity of environment as a whole. Not only this, in our anxiety the raise agricultural production we are distributing pesticides enmass, without educating the farmer properly on the health hazards of such chemicals. Obviously we are playing with their lives and creating environmental problems. Many of our villages which needed only to be cleaned prior to the implementation of economic plans are now exposed to chemical pollutants. It is certainly within the domain of universities to make the villagers conscious of their right to live in hygeinic condition; right to drink purified water; and right to eat unadulterated food.

Mention may also be made here of environmental problems which are more grave than those hinted at above and require to be studied on a vast scale. The formation of undersoil hard pans due to indiscriminate use of heavy tractors, water logging and salinity under the stress of intensive irrigation, denudation of forest for quick economic returns, building up of big dams without an eye on the harmful changes in local ecology, and, protection of lakes and rivers against eutrophication, are some such problems we are encountered with right now or may be facing in near future. Without going into details it should suffice here to say that each one of them is highly complicated and comprises of multitudes of ecosituations. Further, the nature and magnitude of an ecosituation differ spacewise and are likely to undergo changes in time. Thus the data from a particular situation are neither applicable to the same situation for ever, nor can they be profitably utilized to understand an apparently similar situation in regions with different climate and topography. In other words every ecosituation is so individualistic and dynamic that it has to be studied specifically and continuously. To my mind the most economic and effective approach to meet this challenge is through cooperative researches hinted at earlier. These researches then could serve as the building blocks for environmental planning at regional or national level. There may be short cuts to economic development but probably they do not exist in the environmental planning. If by passsed ecology can undo economic gains.

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Environmental Research and Employment of Environmental Graduates

Sarada Kanta Sarma

TO FULFILL the basic requirements of living and with their indomitable urge for comfortable Living and to know the unknown thing human beings are gradually encroaching upon the realm of environment and scientists empowered with modern scientific tools and technological know how are causing serious dent in the nature. Consequent upon these unsystematic forays in the realm of environment human beings are boomeranged with multifarious problems which have caused a serious concern for our peaceful existence on the earth. To cope with such problems the new branch of science called environmental biology has developed. This branch of science which should be studied through a multi-disciplinary approach, involving non biolgical sciences too specially becoming unavoidable in the age of modern development of sciences.

With the fast growth of human beings on the earth, some other concomitant problems are arising. These problems are growing to be more acute day by day in the poor as well as rich industrial countries. The problems, their nature and intensity of course becoming different but, at a time they are contributing towards the health hazards of inhabitants of all parts of the globe. Some of these problems in the poor countries where population growth rate is tremendously high are deforestation, soil erosion, silting of river beds, pollution of different nature mainly from the wastes originating from human, animal and plant life and due to lack of necessary knowledge of hygienic living. In the rich countries where industrialisation has reached the peak and benefit of scientific development is shared by almost each and every body, the problems in their environment are of basically the same as in the poor countries, like environmental pollution, may it be air, water, or soil. But here the main source of pollution are the industries or factories.

But in a developing country like India, today we are going to face the environmental problems of both the poor and rich countries. In such a large country where more than 650, million people live, moreover their growth rate is fantastically high in comparision to the European or other advanced countries. No body can deny the need for the extra land for housing, cultivation and for more energy. This obviously results in the beginning of the problems mentioned above. The situation is becoming more aggravating due to very low standard of living of she majority people which is unavoidable.

To day we are becoming conscious about the problems created by human beings towards its environment which is becoming quite alarming for our existence on the earth. At the same time no body can deny the Population growth which is a natural phenomenon. So this is the high time for us to evolve or formulate some pragmatic approach for the peaceful existence of us on the earth.

To cope with such problems, the need for environmental biology as a subject to be taught becoming very much essential. And this should be the duty of environmental graduates to see that there exists a balanced natural system and a systematic, planned and regulated utilization and exploitation of it for the long term benefit of mankind. This we must admit that population growth and scientific development is the main cause, why environmental biology should be taught as a subject and consequently environmental graduates should be entrusted with particular jobs like helping to maintain a purified environment and a well balanced natural system.

But unfortunately in India though we are facing such a serious problem in our environment, still we are remaining stoical to our surroundings and it seems as if it is nobody's business to work for a better surrounding or a healthy environment for our undisturbed existence on the earth, and if proper steps cannot be taken at this time it will take a devastating form in the near future. Considering this aspect, our government should immediately give a favourable consideration to establish "*Environmental Research Centers*" in every state. The main role of these research centers would be to find out the nature and intensity of envoronmental hazards of different kinds and to suggest necessary steps to be taken in order to minimize it.

To work in such research centers the environmental graduates will be the fittest men. Just to begin with, the students who are getting post graduate/Doctoral degrees mainly in biological sciences with proper knowledge of environmental biology, should be employed in those research centers. To help them to study the environmental problems more acurately, experts of other disciplines like chemistry, physics, geography, engineering, mathematics, statistics etc. should also co-operate. In order to equip the students with knowledge of environmental biology each University should introduce the subject and it should be able to cast a deep impression on the minds of the students about their surroundings, its proper planning, so that no unexpected and deleterious affect is caused at any time to the biological systems due to lack of our far sightedness. The students after undergoing such a course should get employment in the environmental research centers.

The environmental research centers should have their substations at different places of the states, particularly in the more vulnerable areas. The environmental graduates should keep constant touch in both urban and rural areas to make proper estimation of the problems. They should work in association with the experts of other departments like forest, agriculture, public health etc. In the rural areas where majority people live and most of them are illiterate, the environmental graduates should study the harmful affects of malpractices in cultivation, deforestation, soil erosion, silting of river beds etc. and should advice the people who are responsible for it, the alternative path to be followed after pointing out the ravages of such malpractices. Also they should suggest the government or other departments concerned, the necessary steps to be taken to meet the demands of the rural people. No doubt this will be a great service to our nation not only for the present, but for our future also. The environmental graduates should work with the medical doctors specially for giving proper advice to our rural people about the importance of hygienic living and how it can be achieved Besides they can be of tremendous help in convincing the rural people about the need of family planning.

In the urban areas where the problems are of varied nature, the environmental graduates can be of immense help for the betterment of the day to day life of the urban dwellers. In the urban areas, the polluted environment is mainly due to two factors. In the industrial towns and its vicinity, the air, soil and water cannot escape from getting polluted by the industrial effluents. In the busy towns and cities also the same condition prevails. On the other hand, in the urban areas where exodus of people from rural areas in search of livelihood takes place, the situation is different. Most of the people being very poor and illiterate cannot afford a hygienic state of living. As a result, they used to live in a very miserable condition and gradually pollute not only their environment but also beyond it. Therefore, in the urban areas the work and responsibilities of environmental graduates will be more stringent. They will have to be more active in the urban areas, and will have to find out the causes of environmental pollution (air, water or soil) and be able to suggest methods to prevent it.

In our country we have so many lakes, ponds water reservoirs etc. in both rural and urban areas many of which besides helping us in many ways also appeal asthetically. But most of them are in a process of eutrophication due to lack of proper exploitation. So, it should be the duty of environmental graduates to bring them back to normal condition, so that we do not deprive ourselves of such a precious gift of nature.

To achieve these goals, if government can provide them necessary facilities to work, then no doubt they will prove the worth of establishing the environmental research centers. On the other hand in such research centers more young scientists from different disciplines will get proper employment and being closely associated with it, they will be able to suggest concrete measures to follow, which ultimately will help to build a healthy nation. We must remember that without a healthy environment, a healthy nation cannot develop. So, unless a serious consideration can be given to establish such centers, people will not get conscious about the need for purification of our own environment and environmental education, which in moderd days is as important as food, shelter and clothing.

Therefore, we must welcome such a noble project and must see that the workers associated with it can perform their duties without any outside pressure and can materialize their thinking.

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The Idle Hands of Environmental Graduates

A. Mishra and M.C. Dash

Introduction

MORE THAN forty Universities and Post-graduate colleges in India offer Ecology and Environmental Sciences Courses in Post graduate and undergraduate curricula. A few hundred graduates come out of these institutions with knowledge and skill to work on environmental problems but adequate arrangements to utilise their services are not available in our national planning which causes frustrations and adjustment problems for the persons concerned. Possibilities of availing the services of these individuals have already been indicated (Misra 1978, Kaul and Kaul 1978, and Khopkar 1978) by environmental educators in India but nothing has materialised. An average environmental graduate in India comes out of the institution with the fundamental knowledge of the interactions of the biotic and abiotic components of the environment and gathers a background of understanding of the present environmental problems and possibilities of their solutions, Ecology and environmental sciences deal with ideas taken from various disciplines and it is this inclusive nature of the subject that widens the scope of the learners but in the present context no relationship is found to exist between environmental learning and employment. Lindahl (1978) and Singh (1978) have interestingly discussed the significance of ecological principles for the society and numerous authors over the globe have presented their ideas on the use of ecological principles in the management of all types of resources. We have managed our resources for the last few centuries in ways which have already lost significance and to avoid further problems we have to stick to the laws of Nature in resource management. The environmentalist should be consulted at the begining of all of our so called progressive movements. This is no doubt a difficult mission but not an impossible one. Munn and Sors (1978) discuss principles and problems of environmental monitoring systems which can be very easily undertaken in India. di Castri and Hadley (1978) have also given examples from the MAB projects suggesting strategies of the use of ecological principles in Tropical Resource Management. We can take help of many such publications to prove that the progress in environmental theory and practice are separated by a very wide gulf in the tropics especially in India. There is no use accumulating theoretical knowledge if that is not practised for public benefit. Therefore in the following few lines some possibilities of providing engagements to the environmental graduates are discussed.

Employment Avenues for Environmental Graduates

Fig. 1 exhibits some possible employment avenues. The term environmental graduate should include the undergraduates and post—graduates with a formal background of learning environmental sciences. One of the important fields where these graduates can extend their services is Teaching and Research. The magnitude of environmental teaching at present is quite insufficient. A course of human ecology suggested by Kirpal (1976) and appreciated by Dr. G.S. Puri should be introduced in all educational institutions for students not exposed to ecology syllabi. Khopkar (1978) and Bains (1978) have emphasized the importance and need of teaching of environmental sciences in technological institutes and agricultural institutes respectively. Tiagi and Gopal (1978) have edited the ideas of a number of authors on environmental education at lower and higher educational levels. These suggestions being considered and implemented employment position of environmental graduates in the field of teaching and research will improve immensely. Besides formal teaching in schools and colleges services of some graduates can be utilised as environmental educators for the rural and urban adult populations who do not come to the

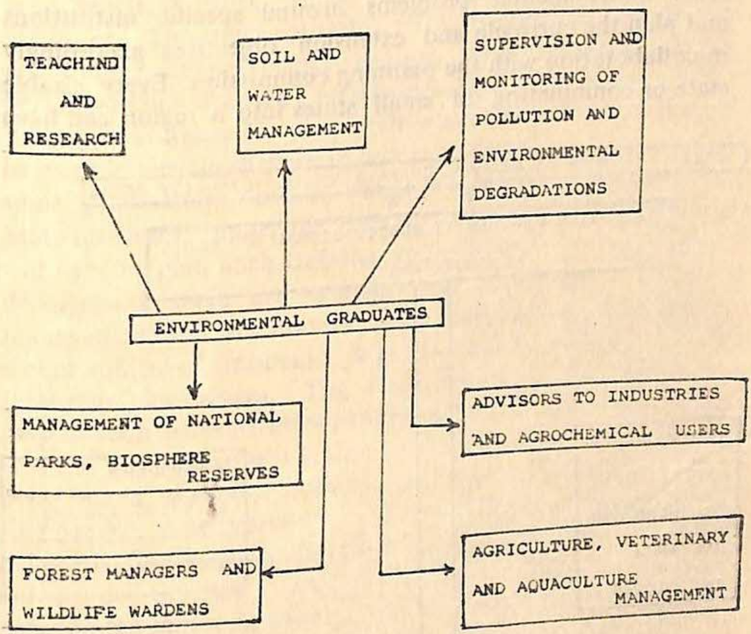
TEACHIND AND RESEARCH
SOIL AND WATER MANAGEMENT
SUPERVISION AND MONITORING OF POLLUTION AND ENVIRONMENTAL DEGRADATIONS
ENVIRONMENTAL GRADUATES
MANAGEMENT OF NATIONAL PARKS, BIOSPHERE RESERVES
ADVISORS TO INDUSTRIES AND AGROCHEMICAL USERS
FOREST MANAGERS AND WILDLIFE WARDENS
AGRICULTURE, VETERINARY AND AQUACULTURE MANAGEMENT

Fig. 1

educational institutions. We have to plan to educate each citizen about the fundamentals of the ecological processes and careful planning is necessary for such a move.

As regards research, India has already taken a position on the world ecological map but there is a need to organise and integrate the efforts. Only research will not solve our problem, it should go hand in hand with extension work. Fig. 2 presents a possible model of organisation for this purpose. The central organisation (Central Institute of Environmental Affairs) can be constituted by Central Government inviting the participation of eminent environmentalists working all over the nation to interact and decide a uniform pattern of University environmental Education Programme. This institute will also look into the local environmental problems around specific institutions and plan the curricula and extension objectives accordingly in collaboration with the planning commission. Every sizable state or combination of small states into a region can have

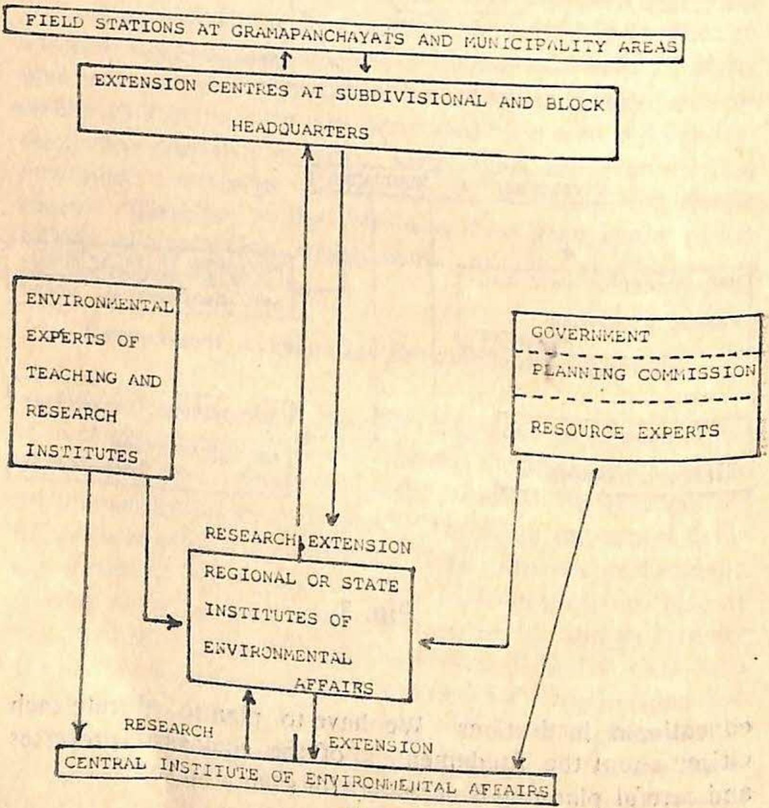
FIELD STATIONS AT GRAMAPANCHAYATS AND MUNICIPALITY AREAS
EXTENSION CENTRES AT SUBDIVISIONAL AND BLOCK HEADQUARTERS
ENVIRONMENTAL EXPERTS OF TEACHING AND RESEARCH INSTITUTES
GOVERNMENT
PLANNING COMMISSION
RESOURCE EXPERTS
RESEARCH
EXTENSION
REGIONAL OR STATE INSTITUTES OF ENVIRONMENTAL AFFAIRS
RESEARCH
EXTENSION
CENTRAL INSTITUTE OF ENVIRONMENTAL AFFAIRS

Fig. 2

State Institutes of Environmental Affairs. The objective of these institutes will be to undertake both research and extension work under the guidance of the central institute. The extension division will plan for the employment of the environmental graduates and choose problem areas for this field stations, both in rural urban and semi urban areas. It will be best to provide some preliminary short duration training to the environmental graduates before they undertake practical work which can be provided at the state institutes. The state institutes will communicate with all the government departments dealing with our resources to participate in refresher courses organised from time to time. As shown in figure 1., the environmental graduates chosen to work in various fields will naturally be required to undergo some prelimanary training about the field problems and the State institutes, under the guidance of the Central institute will have to plan such training programmes. In all the govt. departments there are existing staff in charge of resource management and the senior staff members of these departments will be of immense help for the state institutes with their rich experiences. The State institutes will invite the help of such persons from time to time for deciding issues. It is not possible to give a detail scheme of the organisation here but a separate working group of environementalists, Engineers, Administrative officers, Economists, Political Scientists, Sociologists and other trained personnel can interact to do the job. Considering the intimate relationship between the living systems and the environment, and the day to day aggravation of environmental problems such steps are to be taken urgently.

Under situations of necessity international organisations on environmental problems can be contacted for required technical and financial assistance. di Castri (1978) clearly discusses some problems in the tropical zone working against the sections of MAB. The Central Institute should also plan to tackle such problems. As an advantageous step this institute should be a part of an international net work.

While planning for the betterment of the environment of a particular area the central Institute should take into consideration the problems of the local populations and as far as possible should invite the participation of local people through organisation of public foroums. In this way the local people can contribute a better picture of their environmental problems on which research and extension planninig can be undertaken. The problems of environmental monitoring should be given proper attention at the time of planning. The type of monitoring problems discussed by Munn (1978), will be of immense guidance. The most important function of the environmental graduates through the organisations suggested will be to study the resource consumption by the population and to see that in their working areas the resources are managed properly through strict ecological principles. For example an environmental graduate working in an industrial township can gather quantitative information on sewage disposal, solid waste disposal from households and factories, air pollutants and other effluents polluting the nearby water systems and prepare required models. In collaberation with the existing departments this worker can plan for the management of the environnment, taking care to see that the ecological principles are given proper attention.

Similarly an environmental graduate in the field of wildlife and fisheries management will be a best fit with his background of technical knowledge on population laws, Ecological Principles of competition predation and food chains etc.

An environmental graduate in the Forest Department can look into the integrated relationships between soil, plant and animal components and to see that a balance is maintained between these components while silvicultural practices are under-taken. He can also look into quantitative aspects of forest productivity and succession and suggest consumption strategies.

Similar examples can be given on the role of environmental graduates in Agriculture, Veterinary, Soil and Water management and other environmental and resource management systems.

Environmental Graduates of Orissa

Orissa has three universities offering environmental biology in the postgraduate and undergraduate level. Every year for the last seven years about twenty post graduate students come out of the universities with a specialised fundamental knowledge of Ecology. As far as known about thirty percent of these graduates are engaged in teaching and research and the others have taken employments where they can not use their knowledge. Orissa has a number of environmental problems. The land, forest, mineral and aquaculture resources of orissa are managed without the application of ecological principles. The environments of all the urban and rural habitations of Orrissa need immediate ecological attention and this is most urgent in the industrial belt of the state. Quantitative studies on resource utilisation and pollution problems have not been in this state. Deforestation, erosion on a deforesed land, Environmental changes associated with the building of largs dams etc. are some other common environmental problems where the environmental graduates could have worked but where is the provision ? Orissa has 51.639 villages in 56 subdivisions and 314 Community development blocks. The Government of Orissa should immediately plan to employ at least two postgraduates with knowledge of environmental sciences at each subdivisional headquarters with a responsibility to study quantitatively the environmental problems of the area. Minimum field and laboratory needs should be supplied to these workers and they can take guidance from the state level organisatien of experts dealing with environmental resources and teachers and researchers in the field. These workers will provide quantitative data on the basis of which further planning can be done and target should be kept to avail the services of at least one environmental graduate in every community Development Block within two five year plans. There is no doubt that it will cause some financial load on the state government, but the load can be easily shared. Departments like Agriculture, Forest, Mining etc. have financial outlays from which a possible amount can be diverted for t his requirement. Or the State Government can have a separate financial outlay on environmental research, extension and employment andfor the implementation of environmental education in the State.

Conclusions

The urgent requirement for India now is to form a single Central Institute of Environmental Affairs which will take up all the environmental problems with the Central Government. This Institute will gradually try for environmental education. research, extension and all other environmental issues. This Organisation should possess the power of deciding finally over the plans of resource management and all State Governments should decide to work with the advice of the experts of this institute. The environmental graduates as well as their teachers should now be on the efforts to create field for their employment.

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Urban and Regional Planning in India and Implications for Planning Education

Jamal H. Ansari

THOUGH INDIA has had a tradition of town planning and town building since ancient days of Mohanjo-Daro and Harrappa, the evolution of current practice of Urban and Regional Planning can be traced back to 1898 when Bombay Improvement Trust was created. During these years, scope af planning practice has widened from piecemeal efforts of road widening, plantation of trees, city beautifying and sanitary improvements to comprehensive planning of cities and preparation of rigional plans for integrated development. Planning enabling legislations has been enforced in most of the States, and Town Planning Deportments have been created. One of the major functions of these departments is to organise diagnostic surveys—a survey of social, economic and physical aspects of cities and regions and prepare development plans for the next 20 or 30 years. Planners now have the authority to plan and have been performing the plan-making role in a technical capacity.

However, they do not yet seem to have an authority to implement these plans. The responsibillities of implementation of these plans are divided and assigned to various agencies, prominent amongst these are the Improvement Trusts, Development Authorities, and Municipalities. But other agencies involved in urban development are a host of special purpose agencies such as housing boards, slum clearance boards. transport undertakings, water supply and sewerage undertakings, electricity boards, etc. Similar fragmentation of responsibilities is evident at the State level, where numerous departments under different ministries look after different components of urban development.

We have evolved an arrangement under which town planning departments prepare the plans, Improvement Trusts or Development Authorities or any other agency, created or authorised for the purpose, bear the burnt of the responsibility of implementing the plans. By and large, municipalities are expected to take over developed areas for maintenance.

Improvement Trusts and Development Authorities are headed by administrators and, thus, the important phase of plan implementation is not within the jurisdiction of planners.

The Improvement Trusts and Development Authorities perform their functions independent of municipalities; the body of elected representatives. There is also a conflict of interest between these basic agencies. Municipalities complain about Improvement Trusts getting all the remunirative projects and occassionally refuse to pay the share of municipal revenue due to them or take over the assets created by the Trusts. Plan implementation suffers as a result of ensuing political bickering.

On the other hand, planners play a technical plan making role, politicians feel left out of the plan-making process and resist implementation of plans in their own areas of jurisdiction. A planning process which does not encourage participation of citizen or their elected representatives should not be expected to make much headway at the plan-impletation stage.

In order to make planning more effective, there is no doubt a need for planners and politicians acting in a joint manner. One may like to suggest that to achieve this, planning departments be made part of municipal administration. But the difficulty lies in the fact that municipal administration has a subordinate status as compared to that of planning departments which is a State Government function.

Moreover, the low priority accorded to local governments in terms of prestige and pay scales has resulted in poor quality of staff and elected councillors. Metropolitan areas further suffer from fragmentation of urban governments; Calcutta Metropolitan District being the worst example with 30 local bodies in an area of about 460 square miles. The situatian worsens in the case of metropolitan regions where a host of rural and urban local bodies have to be dealt with and, as is the case of the National Capital Regional (NCR), lying in not one State but several of them.

The need for reform in local urban administration continues to be overlooked inspite of the fact that cities in India are growing at a fast rate.

The Indian Constitution while distributing the responsibilities between the Union Government and the States does not mention urban and regional planning in any of the lists—Union, State and concurent (Bhattacharya 1976).

There is no Ministry of Urban and Regional Affairs in the Central Cabinet and the related matters are looked after by the Ministry of works and Housing.

Urban and Regional Planners do not seem to be taken very seriously by decision-makers in the Central and State Governments.

In essence, urban and rigional planners in India have yet to establish their legitimacy to plan, though they have acquired the power to plan. Till now, they have been trying to legitimise their profession on the strength of assumption that planners have a scientific body of knowledge that enables them to challenge irrationality in the piecemeal process resorted to by municipal authorities. Planners have sought to project themselves as independent of political process, and have powers to make autonomous decisions about the future of communities. Present administrative set-up gives planning departments such a plan-making role. However, such a set-up has many flaws. As Rein (1969) has pointed out that autonomy leads to isolation and independence from political process leads to impotence. Authority which does not have the backing of the politcial forces and is merely based on technical scientific rationality, offers only authority to propose, but not the power to achieve. The same is now happening on the Indian planning scene. According to latest estimates more than 600 master plans have been prepared for cities and some for regions, but implementation process is not even initiated in most of those cities.

Planning phase to-date in India can be described as that of plan-making without much of planning. Parallel can be cited here with earlier system of planning in North America when Planning Commissions were popular. But Commission led planning was found to be ineffective, particularly in not seeing plans through the implementation phase. As a result of this criticism, planning was made a municipal function and planners having come closer to decision-makers in the City Halls were able to co-ordinate their activities during implementation phase. However, until the State Governments do something to strengthen the local governments and improve their status, planning staff will remain reluctant to serve as a part of municipal administration.

The efforts of planning national economy have given wide ranging powers to central governments over States in urban and regional development programmes. In a vast country like India where each State represents a micro-nation with its own culture and language, a centrally directeded planning effort is not suited. Under such a system, public participation is minimal and demand on administrative resources very high. Thus in the interest of administrative effeciency, political accountability and public participation, it is essential that planning administration be radically reorganised. State governments should be given more powers to bring about such a reorganisation within their own political framework, and urban administration be streamlined and given adequate powers and resources to deal in a co-ordinated and forceful manner with the intricate problems of modern cities and their regions.

However, the reorganisation of the administrative system relating to planning is one step towards rationalisation) of planning framework in India. The immense gap between the available financial resources and the scale of investment needed for urgently required urban and regional infrastructure, is the other problem basic to all problems. Here are needed some innovative approaches for mobilisation of resources and making plans and programmes which are compatible with these resources. One of the criticisms of planning efforts in India has been that planners have prepared plans without much regard to fiscal and administrative resources of governments responsible for their implementation. Also, these plans are prepared as an exercise in urban design without much concern for existing priorities and constraints on resources. This is a reflection of the fact that an overwhelming majority of our planners come from civil engineering or architecture background. Most of the planning schools in India restrict entry of students with social science background. The Institute of Town Planners. India, hesitates to recognise planning courses with less of design content.

The leading planners and teachers in India today were trained in then heavily design oriented planning schools in Britain and the United States of America. While the planners in those countries are moving away from the heavy physical planning orientation they had, to a planning framework involving society's goals and value systems, planners here seek to prepetuate the planning methodology which has not proved useful.

Weaknesses of comprehensive planning have now become quite apparent. Planners had promoted the concept of comprehensive planning as a result of lessons learned from piecemeal planning. They had understood that solutions of problems without a comprehensive plan usually resulted in worsening of other problems or simply shifting the problems to other locations. Thus, comprehensive planning was presented as an approach of problem solving with the knowledge of *all* inter-related factors and within the time perspective of changes affecting them. The concept got crystalised in the shape of a comprehensive development plan; in case of towns and cities, a plan of proposed land uses accompained by transportation plan and municipal services plan, and in the case of regions location plan of settlements with potential for growth and proposals for improving physical linkages and distribution of facilities and services. Not that planners have not been aware of social and economic dimensions of their profession but somehow our pre-occupation has been with physical dimension.

Basic points criticising comprehensive planning were raised by Altshuler (1965). He asserts that comprehensive planners' claims to comprehensiveness, if they are to be persuasive, must refer primarily to a special knowledge of public interest. In other words, a comprehensive planner should be able to identify the unified public interest and express them in terms of community goals. There are difficulties here, since different interest groups may have different goals which are competitive and conflicting. Some means of bargaining process through public participation is suggested in identifying the public interest. But, problems of finding discussants and proceedings for meaningful participation by a public which would represent all shades of interest groups have been raised. Some other weaknesses of comprehensive development plans have been pointed out by Friedman (1971) Candeub (1970), Gans (1970), and others, They point out that comprehensive plans are:

1. Static; once-for-all statement about the future shape of cities or regions 20 or 30 years hence.

2. Makework Plans; filling gaps through intuitive judgement.

3. Demanding in terms of co-ordination which never exists; co-ordination is more an exhortation rather a reality.

4 Not even comprehensive; as they are confined to physical aspect.

5. Ignore poor and weaker sections of society; are suited to business community interests and other middle and upper income class residents.

6. Focussed on long-range problems which is often at the cost of immediate problems needing immediate attention.

7. Time consuming; by the time are prepared are outdated.

8. Generally not backed by statements of fiscal institutional measures or policies.

It seems quite obvious from what is said above that master plan type of planning being practiced today is narrow in outlook, rigid in approach and difficult to implement. Planning schools which prepare their students for this very type of plan making role, not only help perpetuate these flaws in our planning approach, but also face the danger of getting inflicted and stifled by the rigidities and unrealities inherent in the approach.

In view of the lessons learned from the experience of planning in the past, elements of the kind of discipline we ought to pursue in future are being stated below.

1. Planning as a Process: formulation of strategies and tactical schemes with clearly defined goals, careful selection of options, choosing amongst alternatives, continuous evaluation and revision.

2. Participatory Democracy: encouraging public participation.

3. Positive Planning: clearly delineated objectives and action oriented plans rather than remedial or negative policies.

4. Pluralistic : if about 80 percent of our population lives in rural areas and a large majority of our total population is poor, our planning effort should also contain a similar bias towards rural areas and the poor.

Thus, if we need to be flexible, realistic, and incorporate values and goals of society, we need to substantially increase the non-physical content of our planning approach to impart creditibility to what we propose for physical improvement or development. Inevitably, what we want to change in the process of planning must get initiated in our planning schools. If our students have to be prepared for a change seeking role, and the change we need to bring about in planning profession to make it more realistic, the structure of planning education has to be so devised that it becomes the hallmark of flexibility and reality.

Fagin (1970) and Gans (1970) have projected thesis that planning is basically a methodology that is transferable to all efforts to achieve selected goals by systematic application of resources in programmed quantities and time sequences designed to alter projected trends and redirect them towards established objectives. This approach argues that what makes planning a discipline and its practice a profession is *what* it does and *how* it does not where and to what it does. According to them planner should be an expert on delineating action programmes to achieve chosen objectives. Planning as a methodology need not change whether it is applied to manpower planning, open space planning, mental health services planning, or chalking out development programmes at urban, regional or national level.

Fagin (1970) has further identified the elements of a planning discipline—*planning per se*, not the traditional planning which tries to compartmentalise planning into city planning, regional planning, transportation planning, etc. The elements are ;

1. Analysis; division of whole into component parts (system into sub-systems), understanding of how these components function and how they interrelate with each other.
2. Synthesis; assembling of parts into a whole to create new constellation of ideas, arrangements and programmes. This element is partly creative and partly helped by analysis.
3. Collaboration; with specialists, planners in different agencies, and different interest groups.
4. Education; education about planning within the ranks of profession and outside.
5. Mediation; balancing different interest groups. Planners' input here is to indicate possible actions, taking into consideration various constraints and possibilities, implications of each action.
6. Prediction; predict possibilities and implications; use of simulation, statistical, probability methods, etc. are suggested here.
7. Advocacy; advocacy of different interest groups.
8. Administration; spelling out plans in terms of actions, monitoring of implementation, legislation for action, identification of agencies involved and assignment of tasks.

If we accept the thesis that a common theme of planning runs through planning efforts in various substantive areas, then the planning education in these substantive areas can be provided through a single programme designed around a common core. The above elements identified by Fagin can be very helpful in developing a broad based core programme in planning education. The choice of substantive areas would depend on various factors such as areas of specialisation of available faculty, financial resources, etc. But, as far as possible, the issues and problems at national, State or local levels should determine the choice of the substantive areas. Areas such as Rural Planning and Development, City and Metropolitan Planning, and Planning for the Poor come readily to our mind. Others pertaining to a region can be picked-up by the planning school located in the region.

There are many variations in structuring of programmes of planning education to take care of orientations in specific areas. Seelig (1974) has identified five such alternatives: (a) mandatory programme with little or no choice of elective courses (b) mandatory core programme plus choice of streams (c) mandatory core programme and electives (d) streams without mandatory core (e) no mandatory core and no streams. Seelig's work is based on the study of North American planning schools conducted in 1971. According to him a mandatory programme with lttle or no choice of electives is rarely offered now. Alternative (b) has the advantage of providing expertise in a specific field of study and is offered at many leading planning schools. The disadvantage of alternative (c) is that many students pursue a programme which has no strong emphasis on a specific area related to urban problems and they often find it very difficult to relate their educational experience to their future careers. Alternative (d) was offered only at the Massachusetts Institute of Technology (M.I.T.) and was considered as one of the best programmes available there and possibly even today. However, this structuring of the programme there had become possible because of a strong faculty with strong commitment to specific streams and access to courses offered in nearby Harward and Boston Universities. Lately, M.I.T. has gone back to the alternative (b) as it is felt that a core consisting of set of courses focusing on Quantitative methods is essential. The skill in the use of quantitative methodologies is considered essential for planners as decision-makers seem to want the proposals backed by hard facts. The alternative (e) was, then, unique to the Univnrsity of California at Berkeley. According to Seelig, many professionals and educators considered Berkeley's programme the best one available. Major reasons for the success of the programme was the school's large and diverse faculty and the fact that many of the faculty members were among the most capable professionals and educators available then.

An analysis of programmes available in seven of the eight planning schools (Ahmedabad School excluded) in India indicated that alternernative (a) is adopted with some variation. The School of Planning and Architecture, New Delhi, offers three streams in urban and regional planning, housing and community planning and traffic and transportation planning after a common core programme. However, once a stream is chosen, all the courses offered under the stream have to be taken. Choice of electives within a stream is not available. Kharagpur School provides two seperate specialisations, one in city planning and the other in regienal planning with a small common core. Roorkee School has chalked out a revised programme to be effective from 1978-79. Under this programme choice of electives is proposed to be substantially increased. However, this School offers one core programme with no strems. An overwhelmingly large majority of students in most of the schools in India come from architecture and civil engineering background. Few with Geography are also admitted. The entry of students from other disciplines (with the exception of Ahmedabad School) is limited by the schools.

Conclusions

Urban and Regional Planning as practiced to-date is characterised by lot of plan-making without much of planning. Planners in India have succeeded in achieving power to plan but not the power to implement. The marked failure in being able to get plans implemented may result from many sources. The institutional framework within which plans are prepared and sought to be implemented has so developed that plan-making task has become independent of political decision-making task. Planners are equiped to play a technical plan-making role but not the political persuasive role of getting the decision-makers realise the strengths in the plan so meticulously prepared. The practice of planning the way it has developed visualises plan implementation as a stage different from plan-making rather than as a process under which feedback from plan-implementation is very much part of planning. The plans are strong in physical and design aspects but not tied to hard issues of resource availability, resource mobilisation and plan administration.

Planning schools prepare the students for this very plan-making role which the palnners in India have been playing for well over two decades now. If we have to focus our attention on plan-implementation, education programmes may have to be provided with depth in various aspects of plan-implementation. For this, plnnning education may have to be broadened in scope so as to supplement the present heavy emphasis on physical aspects by introducing courses on capital programming, budgeting, public financing and plan-administration. Students may have to be exposed to political decision-making process by frequent visits to the meetings in local government institutions and development agencies. May be, a course on political behavior analysis is desired.

One of the skills on which planners have to draw upon heavily, to convince decision-makers about the soundness of the plans, is the ability to use quansitative methdologies for identifying problems, exploring alternatives, and suggesting options. One of the ways in which we can hope to achieve better plan-implementation is to provided the plans the backing of the hard facts of a planning situation. Thus, planning education programme may focus on a set of core courses in quanitative methods.

One of the implications of what has been said immediately above is to move away from a generalist planning framework of planning education to one which provides for expertise knowledge in the problem areas requiring immediate attention in the context of our national, regional and local situations. Some of the substantive planning areas identified are rural planning and development, planning for the poor, and city and metropolitan planning. Some of the important sub-areas are mass-transportation, rural housing, low cost urban housing, urban government and plan administration, public finance etc.

It is suggested that various planning schools in India should attempt to structure their programmes around a set of core courses on quantitative methods, plan-design, capital programming and budgeting, political behavior and plan-administration.

Around this core, depending upon faculty specialisation available, various streams providing opportunity of specialisation in one field or other may be attempted. However, in the context of the present composition of faculty in our planning schools such a restructuring of programmes can be achieved only in the long-run. In the short run, we should attempt to increase the number of electives and encourage a diverse faculty with expertise in atleast one of the various dimensions of planning activity.

However, in order to equip our planning schools with such a diverse faculty in the long run, we may have to immediately discontinue the present practice of favouring architects, engineers and to a certain extent geographers only for admissions in planning schools. We may have to identify a range of disciplines which might contribute to planning and encourage students from all these disciplines.

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